ILLUSTRATING MEDICINE
AND SURGERY

Illustrating MEDICINE AND SURGERY

By MARGARET C McLARTY
D.A. (EDIN)
Founder Member Medical Artists' Association of Great Britain. Member Association of Medical Illustrators (U.S.A.) Artist, United Oxford Hospitals.

With a Foreword by
SIR ROBERT MACINTOSH
M.A. D.M., F.R.C.S (EDIN), D.A.



E & S LIVINGSTONE LTD
EDINBURGH AND LONDON
1960

TO

AUDREY J ARNOTT

God be in my head
And in my understanding
God be in mine eyes
And in my looking
God be in my mouth
And in my speaking
God be in my heart
And in my thinking
God be at mine end
And at my departing

Sarum Primer (1558)

Printed in Great Britain

Foreword

THIS book of Miss McLarty's is the result of persuasion of her many friends, for it seemed a pity that some of the secrets of her success should not be made available to a wider field. Art in medical illustration surely lies in throwing into relief by a variety of means, points which cannot easily be made by the author with words and as a corollary this makes for accuracy and saves much laborious reading. But any economy in time or effort to the reader is not shared by the artist. Dr Johnson tells us that what is written without effort is, in general, read without pleasure (or profit)—and certainly this applies to certain forms of medical art for the final drawing, like the deceptively simple Paris model, is often the outcome of much background thought and work to eliminate anything inaccurate or irrelevant.

Miss McLarty mentions the virtue in a medical artist, of patience, an attribute almost as essential to success as expertize itself. It makes some of Miss McLarty's collaborators uneasy to think of the number of times certain illustrations have had to be modified or redrafted solely because the author has had second thoughts on the subject matter Never has she re sponded other than to smile understandingly

Of the books written by members of the Nuffield Department of Anaesthetics, Miss McLarty has illustrated five (or ten, counting translations) The script has frequently been criticised the illustrations have earned nothing but praise.

This book should have a wide appeal for it shows authors and readers what can be done and to artists it shows the means of doing it.

R. R. MACINTOSH.

Oxford, 1960.

Preface

THE Concise Oxford Dictionary defines the verb illustrate thus make clear explain, explain by examples, elucidate by drawings ornament (book, newspaper etc.) with designs. Modern medical literature of necessity becomes more specialized and at the same time internationally interesting so that it is not surprising that text with illustrations is more popular than reading matter alone. An illustration is the same in any language.

I have sought to set down some fundamental procedures for the making of drawings, paintings and the preparation of charts etc. for general medical illustrating No equipment or drawing material is recommended which cannot be easily obtained. Manufacturers or Importers names and addresses are given should there be any difficulty for people overseas. Any prices quoted are those valid at the time of going to press.

In a book with comparatively little text it could be asked why the Ross Board technique has been described in such detail. The answer is that the preliminary stages of this technique can and should be applied to any drawing, whether it is to be made in half tone, in ink or in colour

The line of practibility has to be drawn somewhere and for that reason animation, moulage, teaching models and the scientific exhibit are not dealt with here. Only material of the widest interest and of the greatest help to the majority of workers in this field has been included.

Medical, printing or drawing terms used in the text are usually explained as they appear or they can be found in the glossary Here other terms likely to be of use are defined briefly In the Appendix there is a page showing the commonest symbols used in the correction of proofs, and some tables of conversion factors which can be useful in the preparation of charts

I hope that the techniques described may be of assistance to authors and teachers of medicine and surgery Many people other than artists have had the experience of trying to explain something and saying "give me a pencil and a piece of paper and I'll show you Visual understanding is true understanding, and the visual presentation of medical and surgical treatments and of facts and figures becomes increasingly popular

I welcome this opportunity to say thank you to some internationally famous people in the medical profession for whom I have been privileged to make drawings. The late Sir David Wilkie, Professor Norman Dott and Professor Illingworth were my first chiefs Mr Hamilton Bailey and Mr Rodney Maingot introduced me to many others whose names head their specialities. At the beginning of World War II I was fortunate to be in Oxford in Professor Macintosh's Nuffield Department of Anaesthetics and with Audrey Arnott we illustrated a series of books for this Department, with an interlude in 1940 when I made drawings for *Sugrery of Modern Warfare*

The post war period had been spent in part time work for the United Oxford Hospitals and in free lance work. This book was begun eleven years ago, and would have been abandoned had it not been for the interest of Mr Charles Macmillan and Mr James Parker of Messrs. E. & S Livingstone. Their constructive criticisms and suggestions have made the work a constant source of interest and to achieve their approval a goal worth seeking. Mr Parker has kindly written chapter xiv Problems of Reproduction and Printing it has the unmistakable authority of vast experience.

We have been allowed to borrow a large number of blocks and permission to do so has been given most willingly Acknowledgement has been made as they appear in the text. The blocks that have been made especially for this book bear testimony to the skilled craftmanship of Mr Hislop of the engraving firm of Hislop & Day Ltd. Edinburgh.

Figures 4 105 133, 136, 137 and 144 are original photographs taken by myself.

It is a pleasure to give acknowledgement to Miss Brensis of the Department of Anaesthetics who kindly typed this book in the early stages, and to Dr Leatherdale lately of that Department who read and corrected the first text. During this last year Mrs. Bernard Smith has been most helpful with her typing and Mr E. L. P Tugwell has made prints which have proved useful in planning the illustrations.

I am grateful to many friends examples of whose work is shown in this book, and to others whose work is not shown, for all of them have given me ideas some of which I hope I have been able to pass on.

MARGARET C. MCLARTY

Oxford, 1960

Contents

Chapter I

The Place of Art in Medical Teaching

HISTORICAL NOTE

IT is not intended here to give even a short history of art as applied to medicine. This has already been well covered by medical authors and by artists, especially in the United States. The writer wishes merely to mention briefly a few historical facts even if they are already well known to some who may read these pages, because it is the past which moulds the present.

The first medical illustration by which is meant some pictorial record of the art of healing, must surely be as old as man himself whether that record was drawn or carved. Many beautiful carvings depicting medical subjects were discovered during some of the major excavations in Egypt, these will be familiar to the medical research historian, if not to the general reader

A few people may have seen reproductions of some of the anatomical drawings from the Fabrica of Andrea Vesalius, which at one time was thought to have been illustrated by Leonardo da Vinci. It may be that these illustrations from the Fabrica are still the most widely known medical illustrations in the world today The artist who illustrated the Fabrica was in fact Stephen van Calcan, who was reputed to have been a pupil of Titian. It was the publication of the Fabrica towards the end of the 16th century that dethroned the anatomist Galen (A.D. 130) who until that time had reigned as the undisputed authority on anatomy in spite of the fact that most of his knowledge of anatomy was gained from the dissection of pigs. It seems incredible to us now that the dissection of a dead human body should have filled the ancient Romans with horror Christians might be torn to pieces in the arena, but a dissection of an already dead body was not permissible.

Until the 16th century there had been very little dissection as we know it. Superstition and religious scruples, chiefly that of the material resurrection of the body were the main deterrents. Figure 1 is the earliest known representation of a dissection of the human body It is the generally accepted view that Leonardo, Vesalius, and Fallopius who later succeeded Vesalius as Professor of Anatomy at Padua, were the founders of the modern science of anatomy

The Fabrica was a revelation to medical men and artists alike and remained the anatomical dictionary of the world for more than two centuries. This atmosphere of realism, which had been created by Leonardo (1452 1519), and Vesalius (1514 1562) and the standards of accuracy enquiry and execution which they set then, still constitute a challenge to all who are engaged in illustrating medical subjects.

There is in the library of Oriel College, Oxford, a copy of what is generally accepted as the first anatomy book in English, published in 1698 The engravings are excellent and are the work of divers European artists and the comments on the drawings were made by the

London surgeon William Cowper.* An earlier and very similar engraving is shown in Figure 2. In the late 18th century Cheselden and earlier Charles Bell and Antonio Scarpa were three men whose contribution to medical illustration is quite outstanding. Bell and Scarpa were both Professors of Anatomy as well as being accomplished artists and this is surely a combination of skills which must produce the best illustrations.†

In 1894 an event of outstanding importance in the history of medical illustration took place. Max Brödel (Fig. 3) went to Baltimore. As a student at Leipzig he had studied the basic principles of all art work, and chose lithography as a graphic art. To this early training he attributed the high degree of technical finish he had acquired and which he was able later to adapt to his medical work. The tedious hand



FIG.

From MS. in the Bodleian Library Oxford, early XIVth century (Ashmole 399, folio 34). It is the earliest known representation of dissection. The operator in layman's dress is being addressed by physician and a monk. The body has been opened and kidneys, heart, lungs and stomach are lying around. The anatomist is holding the liver. (By permission of the Curator).

* *Anatomy of Humane Bodies.* Illustrated with large explanations containing many new Anatomical Discoveries and Chirurgical Observations with copious index by William Cowper. Printed at the Theater Oxford. MDCXCVIII. Other copies at The British Museum, The Bodleian, The Libraries of Edinburgh and Cambridge Universities, Trinity College, Dublin; the Bibliothèque Nationale and five libraries in the U.S.A.

† WHILLIS, J. (195) Anatomical Illustrations, *Med. Biol. Ill.*, , 66.
BRANDE, W. J. (1954) Antonio Scarpa, 1752 1832. *Med. Biol. Ill.* 4, 7



Fig.

Engraving from CASSERIO Giulio. *De vocis auditusque organis historica anatomica.* Ferrar 1600. Vol. I, chap XX, Table XXII. It is impossible to look at this picture without admiration both from the surgical and artistic points of view (By courtesy of The Librarian, Oriel College).



FIG. 3
Professor Max Brödel

stippling of minute dots and the control of line which is necessary in drawing on stone (lithography) certainly develops patience and the capacity for taking trouble.

That Max Brödel had artistic genius as well as superb draughtmanship cannot be denied His first medical illu tration was made for Professor Carl Ludwig of Leipzig, and to this Physiological Institute, of which the Professor was head, came famous men from all over the world. It was here that Max Brödel first heard about the Johns Hopkins Medical School in Baltimore and in 1894 having worked on the illustration of the anatomy books of Spalte



Fig. 4
Sir Hugh Cairns in 1944 when he was Consulting Neuro-surgeon to the Army

holtz and Braune, he went to America with the intention of concentrating on the drawing of medical illustrations. A year later his friend, Herman Becker arrived to assist him a few years later another old friend, August Horn, also joined them in Baltimore. These three men formed a unique team working each in his own field for the advancement of the illustration of medicine. Several years later Max Brödel founded the Art Department at Johns Hopkins (1910). He had many pupils not only among artists but also in the medical profession, even among first year medical students. If a student could learn to sketch, however

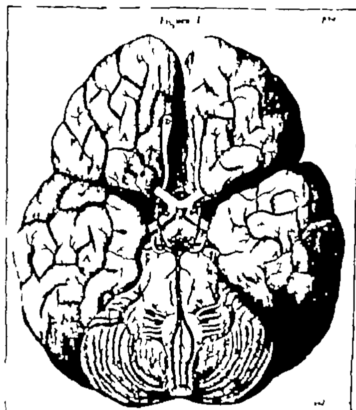


FIG. 5
Christopher Wren's drawing of the base of the brain showing the anastomosis of vessels described by Willis and Lower 1664. By courtesy of the Bodleian Library and H. M. Sinclair and A. H. T. Robb Smith.

From *A History of the Teaching of Anatomy in Oxford* by H. M. Sinclair and A. H. T. Robb Smith. Oxford University Press, 1950.

crudely the Professor believed that better observation would automatically follow bringing with it a better memory for facts, as nothing can be drawn which has not been understood.

Professor Brödel's first student from Britain was Audrey Arnott sent out with a letter of introduction from Mr (as he then was) Hugh Cairns (Fig 4) Hugh Cairns had studied with Harvey Cushing in Boston and returned home convinced of the value of really intelligent illustration In those days, as a newly appointed assistant surgeon at the London Hospital, he was determined to have an artist on his staff and arranged for Audrey Arnott to stay in Baltimore for six months to make a special study of the head for his neurosurgical work. The year following her return from Baltimore, it was the author's very good fortune to learn from her the Ross Board technique and in addition a great many other principles of drawing which only a gifted teacher knows how to explain. Miss Arnott's drawings, a few of which are shown in this book with the author's comments, contain some of the best information it is possible to give

to anyone working on medical illustrations.

Sir Hugh Cairns and Professor Brödel never met, but their burning enthusiasm for the job in hand could not fail to be communicated to their pupils. They had the gift of organisation and of inspiring their pupils to go forth, or perhaps it would be more accurate to say return to the far countries of the world and in due course to teach and demonstrate to others what they had learned. Sir Hugh did not consider an artist a 'luxury' but an essential member of any medical team whose aim it is to teach and to write, as well as to heal the patients under their care.

Here and there throughout the centuries it has been the privilege of artists to assist doctors by making drawings or paintings of medical subjects. Sir Christopher Wren made a drawing of the base of the brain (Fig 5), and many other artists, most of whom do not bear illustrious names, have contributed illustrations of various kinds.

The author while working for the Nuffield Department of Anaesthetics has seen and re drawn in a more modern manner a great many pictures which illustrate the history and development of anaesthesia. Dr Epstein, who has been responsible for this research, commenting on the beauty of some of these drawings has pointed out, too, that many were inaccurate. It seems that occasionally these illustrations must have been made, not from the objects themselves, but from a verbal description or from the accompanying text where detailed measurements were not included. It seems strange that anatomical drawings skilfully depicting dissections (which must have deteriorated all too rapidly) should be accurate, whereas the drawings of inanimate objects and apparatus were not always so. It was decided that these explanatory line drawings of historical objects which were to be used for teaching should show how the apparatus worked in addition to being easily recognisable as the object illustrated. This should be the aim of all medical and scientific drawing.

In 1952 the Abbott Laboratories, of North Chicago produced three pictures in full colour from the Fothergill Collection at the Pennsylvania Hospital. These illustrations, which are known as the 'Fothergill anatomical paintings' or the 'Van Riemsdyk crayons' played a large part in the early medical teaching in the United States Very little is known of the artist Jan Van Riemsdyk, who was a Dutchman, except that he made many drawings in London for William Hunter around 1760 They are superb medical illustrations, and one is reproduced here (Fig. 6). It is a sad reflection on the pace of modern life that it would be considered uneconomic for an artist to spend sufficient time to produce illustrations of the calibre of the Fothergill painting, or even of many of the early illustrations executed by Max Brödel, and his two friends.

Undeniably the trend now is towards simplicity and speed, concentrating on the essentials, though the essentials should not be so streamlined as to be unrecognisable as living structures!

Artists have always been dependent on a patron, whether that patron was the Pope himself or an enlightened medical man. Many artists today have reason to be grateful to an unnamed citizen of Baltimore who made it possible for the Art Department there to be placed on a permanent footing

In London, Edinburgh, Oxford, and in the other University towns there are appointments for full time medical artists, though it was individual authors employing an artist who first showed the medical schools and hospitals the value of a medical artist as a permanent member of the staff.



FIG. 6

The foetal circulation, the abdomen of the foetus has been opened, the placenta is in situ in the mother (By courtesy of the Governors of the Pennsylvania Hospital and Library).

Chapter II

The Function of a Medical Drawing

If indeed it is the function of a medical or scientific drawing to demonstrate some point or points to other people, then the aim of the artist should be to make the illustration clear—a visual *aid* and not a puzzle for the reader An artist in general draws what he sees, whereas a scientific draughtsman makes an accurate reproduction complete with measurements, so that the object drawn could be made by a craftsman or manufactured, as the case may be. A medical illustration should contain something of both the artist and the draughtsman. Scale, proportion and perspective are all important the technique is a matter of choice. Elaborate techniques are of little use if the proportions are incorrect and the perspective is poor Perspective gives depth and reality and is instinctive in the trained artist who will achieve form whatever he is drawing.

It is sometimes a matter of controversy whether a certain subject should be illustrated by an artist or whether it should be photographed. Most authorities agree that the secret of success in illustrating scientific subjects lies in the proper co-ordination and selection of the various media available. Visual aids may consist of anything from one line to a most complex projection drawing or they may range from the X ray film of a simple fracture, through clinical photography to the best a fundus camera can produce. A simple type of projection drawing is shown in Figure 7 and it illustrates exactly what is meant by a visual aid.

This book is concerned only with techniques in illustration as used by an artist. There will be many occasions on which the illustration of choice will be the photograph. There is a popular saying that a specialist is A man who knows more and more about less and less It is certainly true that there are more and more specialties in the teaching of medicine, and this means specialties also in the illustration of medicine. No one artist can hope to deal with them all satisfactorily However a qualified medical artist presented with an object, an idea, or a series of figures, should know the type of picture best suited to illustrate this particular subject. If a picture is intended for publication in a book, a half-tone drawing may be more suitable than a line drawing. On the other hand a line drawing may be preferable to a half tone illustration if it is for a journal which may be printed on low quality paper On very thin paper the printing from the preceding page often shows through as marks or blotches on a half-tone drawing.

To repeat, the trend in medical drawings today is towards simplicity concentrating on the essentials and leaving out elaborate detail which formerly might have been considered necessary For instance, an operation series may consist of one main drawing showing the whole extent of the wound, followed by several close up pictures recording the succeeding stages, whereas formerly the whole wound would have been included in each drawing. (See Chapter IX.)

It has been said that the medical profession does not want artistic quality and that the preliminary sketch is often much more pleasing to the man who wants the picture, than the so called finished drawing. The ideal is not a choice of one or other but a combination of both. An artist who has the knowledge and ability to recognise and select the important facts and to illustrate them simply will surely satisfy the medical authority

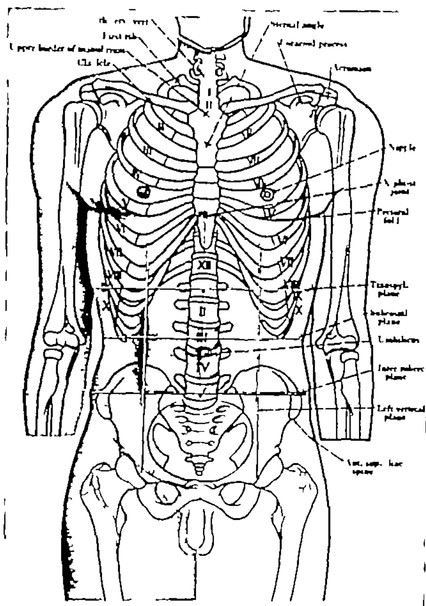


Fig. 7

Projection drawing, simple and essential in the visual teaching of anatomy
From *Illustrations of Regional Anatomy* by Dr E. B. Jamieson.

In the following chapters techniques are described which have been found successful in illustrating various aspects of medical teaching Psychological types among artists vary so greatly that the approach of each artist to his work will be entirely different, even when using the same technique. There is one point however on which one cannot be too insistent, and that is accuracy If possible, every drawing should be checked over by at

ast two people before it is made into a lantern ide or used for publication. Those who are naccustomed to making drawings for publica on would be surprised to know how easily ome minor slip may be 'passed' by even as many as four different experts and then spotted' the moment it is published. There is n illustration of the circulation of the foetal lood supply which has appeared in different orms in several anatomy books and which llustrates this 'perpetuation of error' It may be true that even some anatomists are unaware of it.

Professor Last, the senior demonstrator in anatomy at the Royal College of Surgeons, has said there should be the closest co-operation between an author and his artist, or author and photographer in order to produce a good illustration. Only in this way can the points under discussion be conveyed to the reader

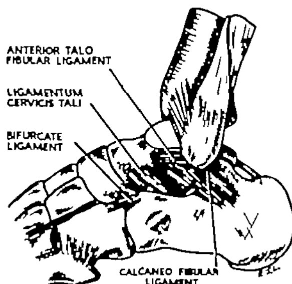


FIG. 8
Lateral view of the left ankle joint drawn from specimen in the Royal College of Surgeons Museum.

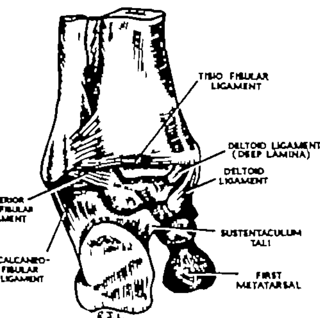


FIG. 9
left ankle and heel from behind, drawn from the same dissection.

The Professor recently published a textbook on anatomy in which he drew many of the illustrations himself. He felt his intimate knowledge of the subject compensated for lack of artistic technique, and that his pictures show what they are intended to show These two line drawings are typical of the Professor's illustrations and the reader may wonder why he complains of lack of artistic technique! (Figs. 8 and 9)*

It may seem obvious that an illus tration should show what it is intended to show but in the drawing or photo graphy of human tissues there are many instances where it is extraor dinarily difficult to achieve this. For

---

Figs. 8 and 9 from *Anatomy Regional and Applied*, by Professor R. J LAST (1954) Churchill (*Ankle Drawings*).

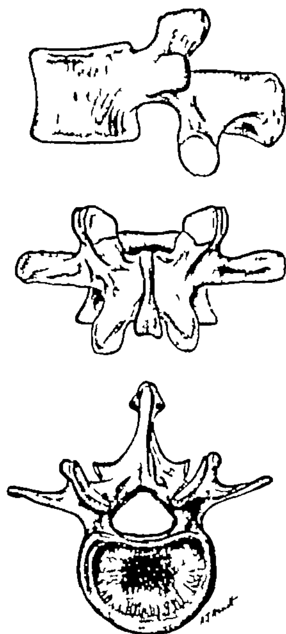


FIG. o
Three views of a lumbar vertebra to assist in the performance of lumbar puncture.

(From *Lumbar Puncture and Spinal Analgesia* by courtesy of Sir Robert Macintosh).

instance one vertebra from the human spine has many aspects, and Figures 10 and 11 demon strate this point. The finished illustrations look comparatively easy but to find the correct points from which to view each of the draw ings of this one bone was by no means simple.

It is easy too, to misspell words when making charts. The artist tends to concentrate on each letter rather than on the whole word. If he is in a hurry as is so often the case errors are liable to creep in. The artist should never hesitate to correct with a good grace any mistake however slight. A medical illustration is useless if it is incorrect. In the preface to *Illustrations of Regional Anatomy* Dr E. B. Jamieson thanks the artist Mr Charles Pearce "not only for his care and skill but also for the good humoured patience with which he spent time in the later stages of a drawing in recti fying blemishes for which I and not he was responsible"

Any artist and especially the medical artist, should understand thoroughly what he is drawing in order to produce satisfactory illus trations The doctor or research worker on the other hand has the specialist knowledge but in all probability has not the skill in execu tion which is taken for granted by the artist. As it is hoped that both groups may find some useful information in these pages, some things that are elementary to one or the other must be included, the purpose being to help anyone who may be called upon to do so, to produce a good medical or scientific illustration to help him to decide what type of illustration he will use, and having done that, to find assist ance in the actual technique of making the drawing. All mechanical aids and short-cuts are legitimate in the making of scientific illus trations.

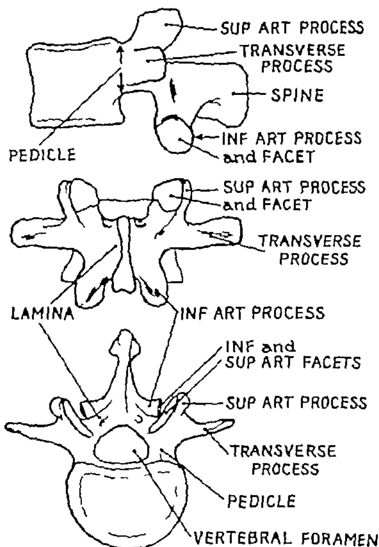


Fig. 1
Line drawings of the preceding figure with the relevant anatomy clearly labelled.

(From *Lumbar Puncture and Spinal Analgesia* by courtesy of Sir Robert Macintosh).

Training

CONSIDERING the number of first class medical schools, authors and teaching hospitals in Britain before 1940 the number of artists fully employed on medical illustrating was comparatively small After the war however there was an increased demand for medical illustrations One problem now that so many more pictures are being used, is to try to make sure that these illustrations are of a really high standard. To achieve this the medical artist of today should have obtained most of the qualifications and training outlined below

1 A better than average degree of artistic ability developed through training. It is generally agreed that four years at an Art School is the minimum time in which sufficient mastery of technique may be acquired. A University degree in Fine Art is equivalent to an Art School diploma, although the actual drawing practice is probably not so comprehensive.

2. A basic course in anatomy under the guidance of a hospital or medical school demonstrator An ideal method is for the artist to work with first year medical students in the dissecting room, concentrating on drawings of the parts dissected, and so becoming familiar with different tissues. Even one limb completely and carefully dissected and drawn is of immense value to the student. Also the matter of fact approach of the medical student in regard to his material cannot fail to be communicated to the artist to his benefit in the future, when he will be working in the operating theatre and in the post mortem room.

3 A basic course in simple pathology and physiology under qualified supervision is considered advisable by most authorities

4 The preparation of three-dimensional models (Moulage) with a rough working knowledge of the materials available and their suitability for different subjects. Moulage includes every form of plaster wax, rubber plastic, or resin model, and is part of the three year course for medical artists at most of the American schools The various Moulage processes are not described here because the techniques in this book seek mainly to assist those who use pencil and brush, or authors who may wish to employ an artist, to decide *how* they would like their material to be illustrated.

5 Knowledge of the principles of designing exhibits for demonstrations and for reproduction, layout, and lettering, with and without the use of stencils.

6 A short course in photography including simple colour photography and micro photography This course should include copying from books, photographs of objects, specimens, and patients enlarging and printing, and the making of lantern slides. As the artist often supplies much of the original material for the making of lantern slides, a knowledge of their preparation, scope and limits is very valuable.

7 Some knowledge of techniques suitable for reproduction and their application to medical subjects, with some instruction in photo-engraving and other reproduction processes. Excellent evening classes in these subjects are available in most large towns.

8 Instruction in endoscopic illustrations *i.e* gastroscopy cystoscopy laryngoscopy etc.

It should not be too difficult to arrange for tuition in these auxiliary subjects In the United States with its enormous population,

there are several well-established schools where the students have whole time teaching in medical illustration, this includes the speci alities listed above. Any artist who has an opportunity to acquire any or all of these qualifications will find that his time has not been wasted, and the knowledge he has gained will be a source of satisfaction to himself as well as to those for whom he will work.

In Britain, with our much smaller popula tion, a single centralized school might be in danger of producing stereotyped students. Accordingly it is generally agreed here that the apprenticeship system is probably the most suitable method for training, and this can be undertaken with an established medical artist attached to a hospital or medical school.

During this period, which should not be less than one year the student will learn some thing of the working and routine of hospital life, and the method of approach to doctor and patient. In the wards he will learn to distin guish physical signs and to make drawings of patients. Finally he will undertake the record ing of surgical procedures in the operating theatre and make drawings for research and anatomical purposes in the post mortem room.

It is greatly to the advantage of the artist that his equipment is so simple. A particularly sensitive patient may be drawn under the guise of taking notes. No paraphernalia accompanies him into the wards at the most there will be a paint box, a cup of water and a drawing block. One extra person at an oper ation requires no rearrangement of the theatre. Only the surgeon, his assistant and the theatre sister may touch any part of, or anything actually on, the operating table, as their gowns and gloves are sterile. No other nurse or even the anaesthetist is what is known as sterile' as applied to an operating theatre. This know ledge of theatre routine brings confidence, and soon the artist will sketch there as freely as anywhere else.

Many admirable and accurate drawings have been made by skilful and intelligent artists possessing very little knowledge of anatomy They made their drawings under medical supervision and picked up medical knowledge as they went along. Also, there are many excellent drawings by medical men with a flair for drawing and painting who have never had any regular art training.

A medical artist on the staff of a large hos pital is expected to carry out drawings and paintings for record purposes, and to make detailed drawings and charts for the teaching of medical students and nurses His work would also be used to illustrate lectures to learned societies, and for journals, textbooks, etc. A good memory for form and colour is essential. Most hospital artists are on call at all times for emergency cases, and they may be called occasionally to other hospitals in the group. Medical animated film work might be needed too. It is the essence of medical art that the artist should draw what he knows and understands, rather than copy what he sees. For instance, a photograph of a post mortem dissection might be indecipherable, but it should be completely intelligible if it is drawn.

Due mainly to the enthusiasm of Dorothy Davison of Manchester University the Medical Artists Association of Great Britain was formed in Oxford in 1949 Some of the members undertake the training of students, and Exhibitions are held every two or three years with the object of maintaining a high standard of work.* Any enquiries should be addressed to Miss Fairfax Whiteside, 169 Russell Court, Woburn Place, London, W C.1

"The Role of the Medical Artist by Dorothy Davison. *The Medical Press*, June 13 1951 Vol. ccxxv No. 5849.

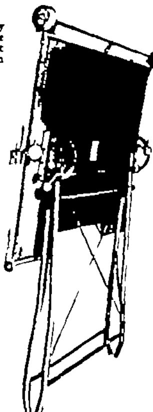
"Medical Artists by Gabriel Donald. *The Medical Press*, January 7th, 953. Vol ccxxx, No. 593

Equipment

UNDER this title item number one is the table desk or drawing-stand, and if a table be chosen it should not be smaller than 54 × 32 inches (Antiquarian). The author's personal selection would be a table of this size and a standard drawing board fitted with telescopic legs for easy angle adjustment. This type of board has a spring wire parallel motion which takes the place of a T square when in use (Fig. 12) An adjustable board and table is more useful than the Compactable Drawing Stand illustrated (Fig 13), because it accommodates reference books and quite a lot of working material which is not possible on a drawing stand, but for an Art Department the drawing stand is an essential piece of equipment. The advantages of a stand are

(a) A spring wire movable transparent parallel motion
(b) easy adjustment for height and angle
(c) it can be folded flat when not in use, and occupies very little space (Fig. 14)





Figs. 13 and 14
Height can be adjusted by means of telescopic tubes, the minimum horizontal height being 43 in. and the maximum 56 in.

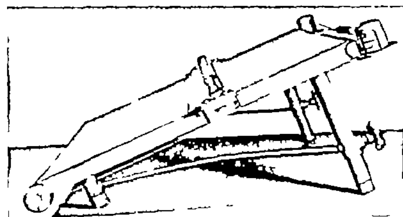


Fig. 12
A standard board fitted with leg supports and the spring wire type parallel motion, combination which makes an extremely portable unit. Made in all sizes.

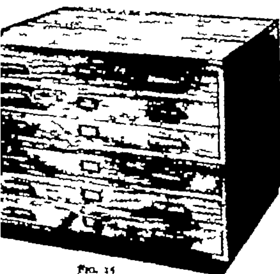


Fig. 15
Plan Chest.

A table or desk on the other hand has two or more drawers where inks, pens, brushes and possibly the smaller sizes of paper may be stored.

A chair is more suitable to sit on than a stool, as it is often necessary to lean back to visualize and consider what the next step will be. Drawings are not always planned on paper any creative artist thinks about his work, and an artist or craftsman of one of the visual arts can often see "in his mind's eye" as the saying is, the finished result, long before he puts pencil to paper He sees the print before the photograph is taken!

A very important piece of furniture is a plan chest (Fig 15). These are usually available in two standard sizes, 42 × 29 × 4 (Double Elephant), and 54 × 32" × 4 (Antiquarian) and they are sold in units of three or six drawers, so that two or more units may stand one on top of the other Even if there are only occasional large drawings, flat storage should be possible, especially during the time when they are in use.

A photographer's trimmer or guillotine is one of the most used pieces of equipment, as all drawings are trimmed at some stage before the finished work is handed in. A metal guillotine is usually ruled in inches so that paper or board can easily be trimmed to an exact size (Figs. 16 and 17).

Instruments should consist of a compass and dividers The compass may be a combination of both, and this is very satisfactory The artist must also have a T square and two set squares, one 45° and the other 30°/60° A protractor may be needed, and a 12-inch or 15 inch transparent ruler is a necessity All these are best if made of celluloid or perspex, as lines and lettering can be seen through them, which

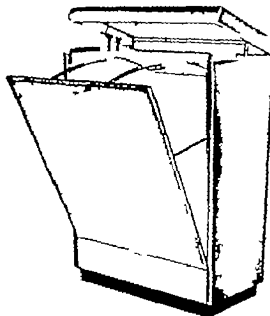


Fig. 15(a)
An alternative to the Plan Chest. The E. V Plan Filing Cabinet is the most economical and modern method of filing working drawings in the minimum space

Figs. 12, 3, 4, 15 and 15( ) by courtesy of the Anglia Engineering Co. Ltd.

2

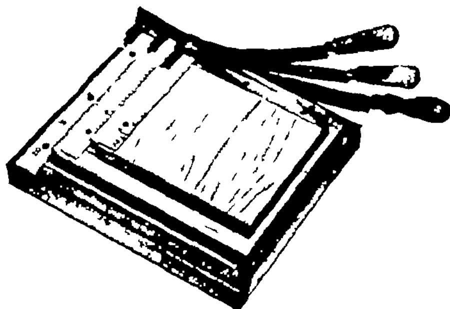


FIG. 16

The Johnson Standard trimmer. The rule is graduated in 16ths of an inch and set at right angles to the blades so that paper is cut square and true to size. 15 inch size.

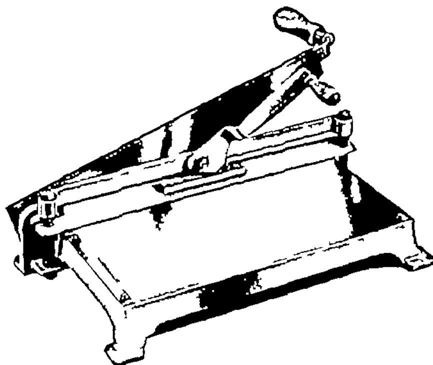


FIG. 17

Universal Guillotine

All-metal construction. Aluminium alloy base casting marked in ½ in. squares. Fitted with squaring guide and lever operated material clamp. 14 inch cut.

is an aid to quick lay-out.* The Center flexible curve of 12 or 15 inches has, to a great extent, taken the place of french curves (Fig. 18). This flexible plastic curve can be bent to pass through the points on graphs It is useful, too, for drawing large ellipses (Fig. 19).

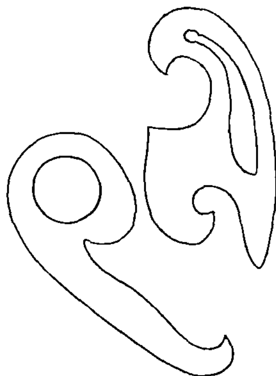


FIG. 8
French curves.

A reducing lens is invaluable when drawing for publication, as some idea of the reduced size is quickly apparent.

Pelikan inks in cartridges and in bottles with a screw cap and pipette are most economical. These inks remain liquid in a stencil pen or in the Graphos pen for a long time, and they are obtainable in 12 colours and black. For those who like to draw with an ordinary fountain pen—and what a beautifully free flowing line can be produced—Pelikan Fount India is a dense black drawing ink specially prepared for this purpose (Figs.20, 21 22, 23).

The nibs for the Pelikan Graphos pen are illustrated on page 26. Others pens and stencils produce similar results, and which to use is a matter of individual preference. This is true also of pencils and indiarubbers The only *must* is Wolff Carbon pencils for use on Ross Board, or Esdee Board No 14 which is the nearest British equivalent.

An X ray viewing box is not essential unless for tracing from X-rays, and these are usually done in that Department where experts are available to answer any questions nevertheless it is convenient to have one. A viewing box with its illumination from behind makes it possible to trace directly on to fairly thick paper

The lighting in an art room or department should be the best available, and during day light hours the artist should sit with the source of light coming from the left. As well as ceiling strip lighting there should be an Anglepoise or similar desk light (Figs 24 and 25). Even though the ceiling light is sufficient, as it should be, for most types of work, extra illumination must be available if the occasion demands it.

The Pantograph (Fig 26) is described in detail and function in Chapter X. It is a most useful instrument for enlarging drawings, maps, etc., and though it is an item of equip ment its operation is not explained here. The operation of the Air brush also (Fig. 27), has to be explained, and this is done in Chapter VIII Drawing papers and boards are described with the techniques to which they are best suited and are not listed as items of equipment for that reason. This applies also to brushes and colour media.

* A perspex T square of Imperial size (28 inches ap proximately) *costs about £2, and 12 inch ruler about 5/*

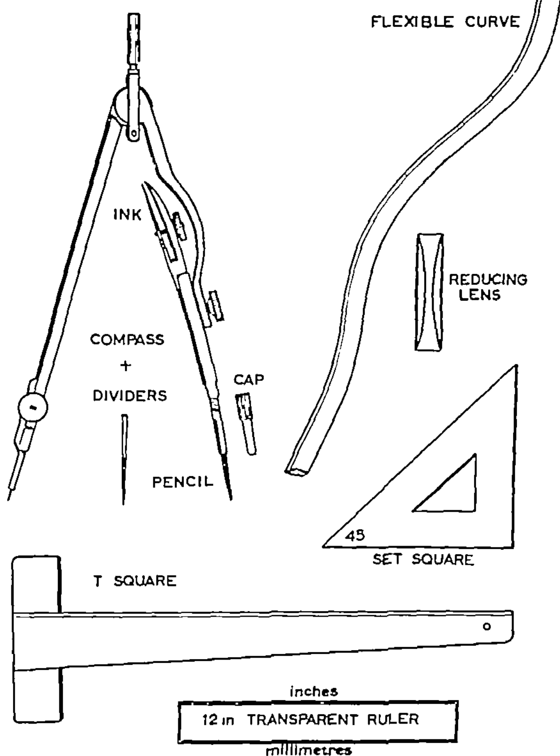


FIG. 19

A compass of 4½ inches minimum length from centre of head to point with interchangeable divider pencil and pen points, is known as Half Set in the British Standard nomenclature of drawing instruments. See Glossary British Standards.

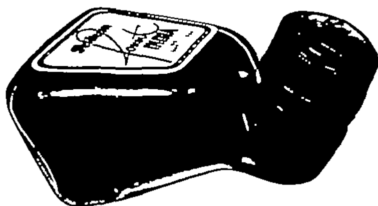


Fig. 20
Fount India is a dense black drawing ink for use in ordinary fountain pens.



Fig. 21
Drawing ink cartridge.



Fig. 22
With screw cap and pipette for filling stencil pens.



Fig. 23
The Graphos drawing ink fountain pen.

(By courtesy of G. H. Smith and Partners Ltd.)

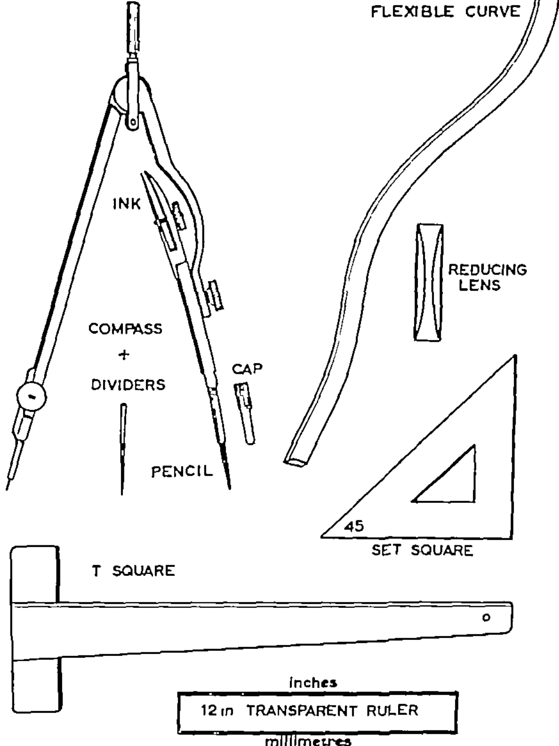


FIG. 9

A compass of 4½ inches minimum length from centre of head to point with interchangeable divider pencil and pen points, is known as a Half Set in the British Standard nomenclature of drawing instruments. See Glossary British Standards.

PANTOGRAPH

FIG. 26

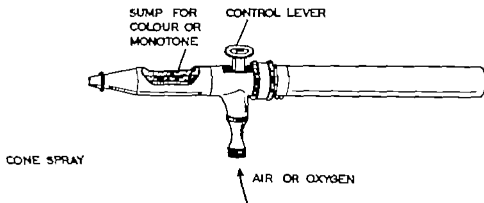


FIG. 27

Lettering

BEFORE the advent of stencils the most commonly used alphabets were Roman Sanserif Old English and Script (Fig. 28) and several hybrid variations of all of them. *These old and beautifully constructed letters* are still used universally by printers and the press, if not by individual artists

Now that there are several excellent lettering guides on the market the art of free hand lettering is less important than it was The ability to produce neat hand lettering is always an asset good lettering of this type *has an individuality which must necessarily* be lacking in a stencil and there are definitely occasions for its use. When ordering lettering guides it is advisable to have a wide selection of alphabets from which to choose and Standardgraph Stencils are excellent in this respect (Figs 29 and 30) The letters are well cut, and the upper and lower case, *i.e* the capitals and ordinary letters, are arranged on the same stencil, which also contains numerals, punctuation, etc. This makes for speed and ease of manipulation. These stencils are made in sizes from 2 25 millimetres the larger stencils must of necessity be divided into two parts. Before ordering any stencils ask to see an illustrated catalogue, because having seen the types of alphabet available, the artist may possibly choose alphabets of condensed letters, *i.e* letters which are upright and narrow rather than those of a squarer type, and there are many types from which to choose.

ROMAN

A B C D E F G H I J
K L M N O P Q R S
a b c d e f g h i j

OLD ENGLISH

London, Edinburgh.
a b c d e f g h i j
k l m n o p q r s t

SCRIPT

abcdefghijklmnop
1234567890

SANSERIF

A B C D E F G H I J
a b c d e f g h i j
A B C D E F G H I J

FIG. 28

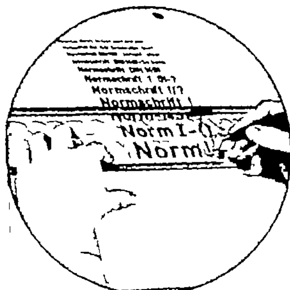


FIG. 29
The Standardgraph lettering guide in use.

*Figures 29, 30, 31 and 32 by courtesy of G. H. Smith and Partners Ltd.

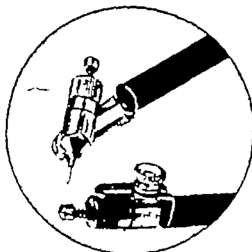


FIG. 30
The Adjustable Penholder permits the pen to be fixed in any position, it may also be turned round and the point placed in the empty space provided in the holder and carried like any fountain pen.

Standardgraph provide pens, for each size of stencil; these pens have a covered screw-on cap which minimizes the risk of ink leakage from the pen, and they fit into an adjustable penholder as shown (Fig 30). Incidentally the Graphos pen already mentioned (Fig. 21) has a set of tubular nibs suitable for both Standard graph and Uno Stencils. The Graphos nib key is illustrated here (Fig. 31). It shows specimen writing for each type of nib supplied.

For filling any of the Stencil pens it is best to use the Pelikan Drawing Ink Cartridge already illustrated, because in a cartridge the ink cannot be contaminated as it can in a bottle, where dust and foreign bodies are bound to accumulate. Unless the pen is cleaned after each stroke, it is bound to leave in the ink some deposit of dust or chalk from the surface of the paper which in turn will make the ink flow less freely through the stencil pen.

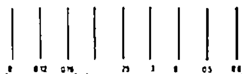
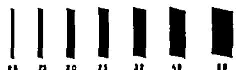
NIB	TYPE	WIDTHS SUPPLIED (in mm)	SPECIMEN WRITING
	**A**		RULING NIBS *FOR* FINE LINES
	**T**		RULING NIBS for broad lines and for writing posters
	**R**		*TUBULAR NIBS FOR LETTERING GUIDES*
	**O**		*Round Nibs for round end lines*
	**N**		Right hand slant nibs for square end lines
	**Z**		*Left hand slant nibs for square end lines*

Fig. 31

There is an American-type of stencil where the slant of the letters can be adjusted forwards or backwards to suit individual needs. At the time of writing this stencil is not yet available here, although it may be ordered from America.

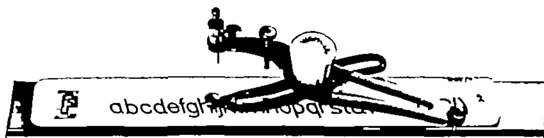


FIG. 32
The principle of lettering with scriber is based on the tracing of engraved characters on the lettering guide, which are simultaneously reproduced on the paper. Pencil, indian ink, writing ink or even diluted poster and water colours may equally well be used. With one lettering guide it is possible to produce upright and sloped lettering.

Standardgraph also produce a stencil of a similar type, the Duograph Scriber which works on the principle of the Pantograph. From the guide, the slope of the letters can be adjusted. The artist follows the letters on the guide, where the letters are grooved and not cut through, and the pen writes at the end of an arm so that the work is clearly visible on the paper well clear of the stencil (Fig. 32). Anyone who does not already possess sets of stencils would be well advised to consider this one before purchasing the older types.

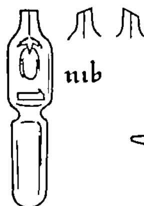
There are a few points worth mentioning in the use of stencils. Do not try to use them without a firm T square, or a celluloid or cardboard strip on which to rest the stencil. Uneven stencilling looks even worse than uneven hand lettering. Best of all for this type of work is the drawing board or stand with its spring wire parallel motion previously illustrated (Fig. 12) which supports any type of stencil set square, etc.

Keep your stencils clean. Keep the pen clean, too bicarbonate of soda in the ratio of 5 parts to 100 parts of water will soften dried ink particles, should the pen or stencil become clogged. To be sure of getting certain words into a given space, start at the end of the right hand word and work backwards in this way the stencilling need never become cramped or project too far beyond an imaginary margin.

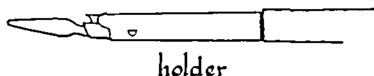
Try to remember to allow enough space between capital letters such as H I M N and U J and L should be carefully spaced, too, depending on the letters on either side. For example, in the word L A MB there should be less space between the L and the A, and more space between the M and the B.

When working with the larger stencils, for instance, Uno 7 and upwards, it is best to outline these letters with a smaller size pen and fill in the space between the lines with a brush,

The pen for script and formal writing.



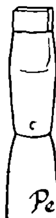
nib

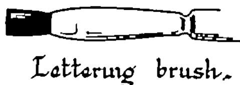


holder



Gillot pen with no 659 nib.





Lettering brush.

Pen with felt nib.

Fig. 34

The Mitchell Pen holder is shown at the top and the nibs may be straight or slant to left or right. A Lettering brush or pen with felt nib will assist in very large script or formal writing.

FG

Fig. 33

because the bigger the stencil pen the more likely it is to blot (Fig. 33). This is a mechanical fact and not necessarily due to lack of skill. In contrast to the stencil pen, however the script pen is easier to use in the larger sizes, and if unfamiliar with this type of pen, the best advice is to practise with the largest size, size 1 on the Mitchell or Gillot cards of Lettering Pens (Fig 34) These are stocked by shops selling artists materials.

For people with reasonably neat hands, lettering with a stencil and free hand, too, is a matter of practice. At first it is necessary to lightly pencil in the layout, but soon it should be possible to produce good work with very few guide lines Always secure the paper with drawing pins or scotch tape, and see that the T square is at right angles to the paper and the basis of a good piece of work is there in front of you

For making notices and displays Graphorel cork letters are very useful and can be arranged with striking effect. These letters are made of cork in at least a dozen different alphabets and in sizes from 5 25 millimetres. Larger letters can be cut on request. The letters have an adhesive backing and are stuck with an additional rubber solution to any flat surface from paper to glass They may be painted or sprayed with any water or oil base paint. It

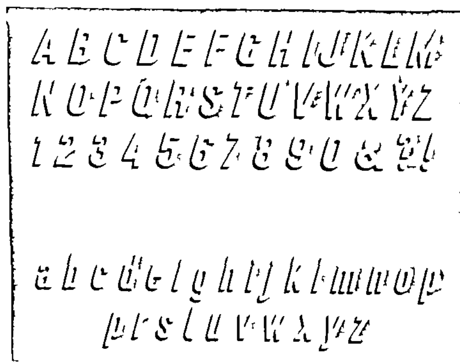


Fig. 35
Graphorel letters, upper and lower case with numerals available in sizes from 5 5 millimetres.

ARTYPE No. 1117

AAAAAABBBCCCCDDDDEEEE FF

GHHHHIIIII JJKKLLLLMM NN

NNOOOOO PPPPQQRRRRRRSSSSSS

TTTTUUUUVVWWWWXXYYYYZZ&&aaa

aaaaaabbbbcccccdddddeeeeeeeee

eeeffffggggghhhhhhiiiiiiiijjkkklllllll

mmmmmnnnnnnnnnoooooooooopppp

qqrrrrrrrrrsssssssssttttttttuuuuuvv

vwwwxxxyyyyzz$$1112233445566 7

7889900 ,,,,,,--,, ""??''''''fiffifl()

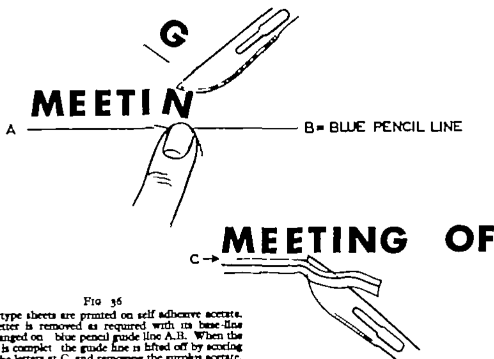


FIG 36

The Artype sheets are printed on self adhesive acetate. Each letter is removed as required with its base-line and arranged on blue pencil guide line A.B. When the lay-out is complet the guide line is lifted off by scoring under the letters at C. and removing the surplus acetate. Finally the letters are firmly rubbed down to eliminate any air locks.

is more economical to order the necessary words and numbers rather than whole alphabets, as the sorting cost is most reasonable. Here again it is a good idea to write for a catalogue, which also includes the price list, to London Industrial Art Ltd., 3 All Saints Rd., London, W 11 Figure 35 is one of the alphabets in this catalogue. With so many mechanical aids anyone should be able to produce good notices, charts and labelling.

In this category too, the Artype alphabet sheet should be included. A sheet from their catalogue shows how this type of lettering is used. Catalogue and alphabets may be ordered from Hunter Penrose Ltd. Farringdon Road, London, E.C.4 (Fig. 36)

More information on the use of Stencils is given in Chapter VI. In any layout composed of words it is advisable to draw a faint pencil line down the middle of the paper When the layout is to be hand lettered, most artists will lightly pencil in the words first inking them later This method ensures a neat and well spaced layout. Light pencilling may be done, too, for stencilling, or an alternative method is to count the letters in each word (counting one for each space between words) having decided how many words will occupy a line, divide the number of letters in the line by two, then start stencilling in the middle of the line, working first to left and then to right. After the first line is finished the next line should be begun in the usual way at the left hand margin. It is important that the words which make the left hand margin of any layout should form a straight line parallel to that margin in the same way as printing in a book.

LETRASET

These are letters from a printed type sheet and they can be transferred direct to any art surface without transfer film or background. Letraset consists of a carrier frame and type sheets from a large range of alphabets. The letters are self-adherent to Kodatrace, Astrafoil, glass, metal or wood.

A new feature is that white type sheets now provide a base for coloured letters. The colour penetrates the surface of the letters only the white base reflecting back brilliant colour whether the letters are used on a dark or a light background. White Letraset is printed on blue paper so that the letters may be easily visible. In application the letters are stripped off' the pre-scored sheet leaving the backing sheet intact down to the last letter and the sheets remain rigid and are unaffected by humidity and are easily stored.

When ordering Letraset it is best to ask for a chart of the available alphabets, an example is not shown here as there are retail agents in most of the large towns. The head office is Art & Technics Ltd., 14/15 Manette Street, London, W 1

Perspective

PERSPECTIVE is the art of drawing an object on a flat surface so as to give the impression of solidity or three dimensions, and to relate its position to other objects. A railway track is the classic example of the effect of distance on two parallel lines The point at which they appear to meet is known as the vanishing point (V.P).

To find the best vanishing point when drawing a given object requires practice for instance having started a drawing it may become apparent that the vanishing point will be beyond the limit of the drawing board. It is therefore useful to remember that a long thin drawing needs a greater amount of perspective than a squat one.

The box and the ellipse are the most widely used basic shapes in almost any type of medical or scientific drawing (Fig. 37).

It is usually possible to simplify pieces of apparatus into a basic box shape for the purposes of perspective, and constructing a good drawing. It is fairly easy too, to draw an ellipse free hand. The construction lines for any ellipse are two lines drawn at right angles on which the size of the ellipse should be measured, the measurements being equidistant from the point

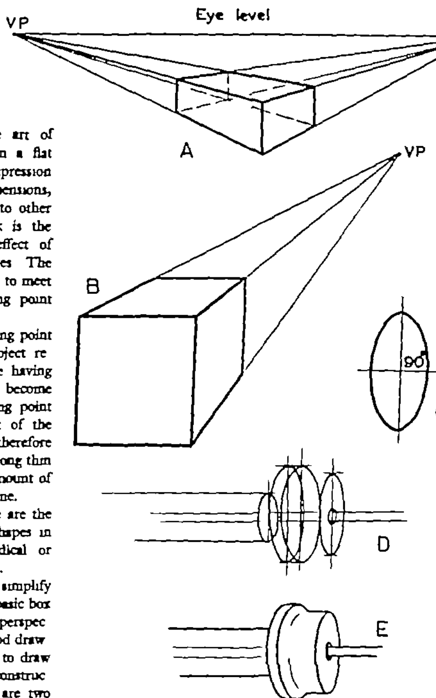


FIG. 37
Sample perspective in the form of two box shapes, A and B. C shows the construction lines of an ellipse D and E illustrate the ellipses which would be used in drawing part of syringe

at which these lines intersect (Fig. 37c). It is very important that the construction lines should be at right angles, otherwise the end result of a drawing based on a badly drawn ellipse will always look wrong. If in making the initial pencil drawing, tracing paper is used it is only necessary to draw one half of the ellipse, then take a tracing of this and slip it under the paper in order to trace in the other side. In fact this is a favoured method of drawing any object with sides which are identical in outline. It is unnecessary to include here the mathematical formula for drawing an ellipse as it is somewhat complicated and would be unlikely to be used by readers of this book.

It is good perspective to draw the lines which are nearer to the eye considerably thicker than those which are further away (Fig. 38). The lines of the needle in Figure 38 are an aid to perspective in this drawing, in which the focus of interest is the point which is furthest from the eye.

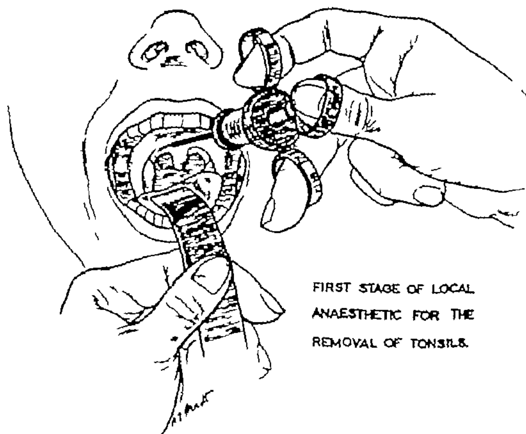


Fig. 38
Illustration drawn for the Department of Anaesthetics, Radcliffe Infirmary, Oxford.
(Reproduced by courtesy of Sir Robert Macintosh).

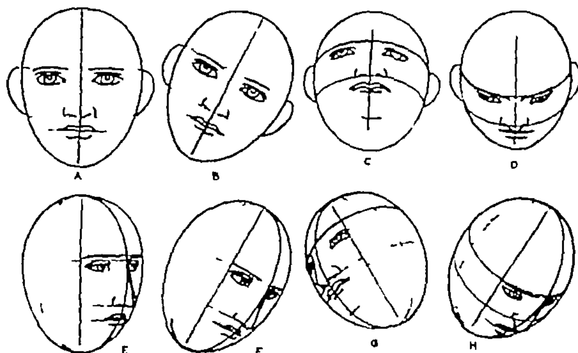


FIG. 39
These pictures illustrate the basic perspective of drawing head in eight different positions.

A human head is roughly the shape of an egg as shown in the series of drawings from a Swiss publication. This consists of a loose leaf folder of drawings of heads of men, women, and children it is one of these sheets which is shown in Figure 39 These folders are published by Ernst Ingold & Co Herzo genbuchsee. This series also includes Hand and Arm Studies (3 parts), and Foot and Leg Studies (3 parts)

Finally Figures 40 and 43 are two drawings which were not done with perspective as their object. The lines to the vanishing points have been superimposed on them and having built up the structure on the finished work it is interesting to see how this has worked out. In Figure 41 the half tone drawing has been traced (from Fig 40) and the lines of its construction indicated the drawing is broken down to use the box and vanishing point per

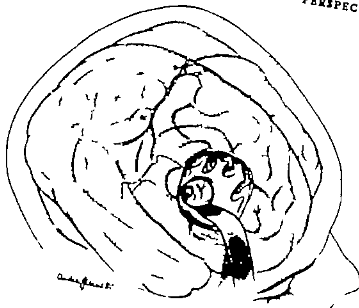


FIG. 40
Drawing of a third ventricle cyst blocking the foramen of Monro.
(Reproduced by permission of Department of Neurological Surgery Radcliffe Infirmary Oxford).

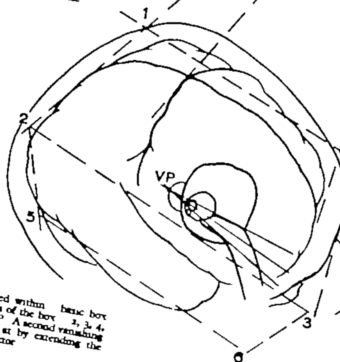


FIG. 4
The brain and head are contained within basic box shape. The lines from the corners of the box 2, 3, 4, 5, 6 meet at the vanishing point V P. A second vanishing point within the head is arri d at by extending the lines of the etractor

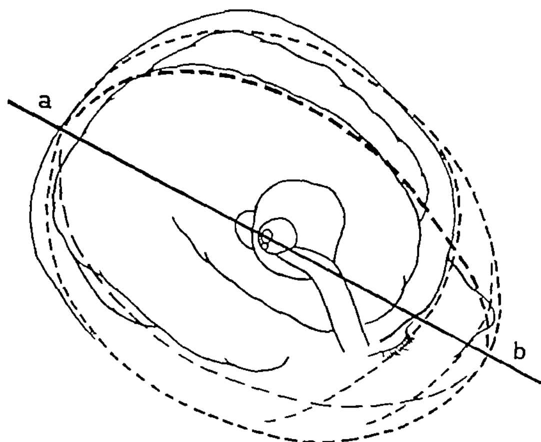


Fig. 42
This time the construction of the head has been based on the egg-shape, with the axis line a b passing through the centre of the field of interest. The heavy dotted line follows the slight cleft where the right and left side of the brain meet.

spective, whereas in Figure 42 it can be seen that the same drawing follows the rules of the basic egg shape of the human head.

On the next page Figures 43 and 44 show that these subjects, too, conform to the rules of perspective. There is a Chinese proverb which says that one picture is worth a thousand words, *and perhaps these illustrations, and* the fundamentals of perspective shown in Figure 37 bear this out.

The ink drawings in this chapter were drawn with a Gillot pen and a crow quill nib No. 659 and Pelican Black waterproof ink. The Graphos pen would have served equally well it has such a variety of nibs that it could *be the only pen in the pencil box.*

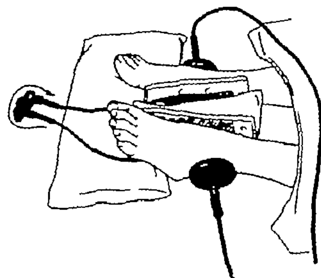


FIG. 41
A line drawing from The Principles and Practice of Diathermy to show the simultaneous treatment of both feet. (By courtesy of Dr. B. O. Scott).

FIG. 44
This drawing has had the main lines of perspective AB and C joined to the vanishing point V.P. to show that if drawing looks right the perspective will stand up to analysis.

Charts

A CHART is a pictorial record of some event or circumstance in relation to one or more other factors A temperature chart for instance is a visual record of a patient's illness. For a medical artist the word chart has come to mean all graphs, histograms and tables, and the best of these do not try to present too much information in one picture. It is much better to have two or even three simple charts than one with too many curves columns and comparisons This is especially true when the chart is to be used as a lantern slide every

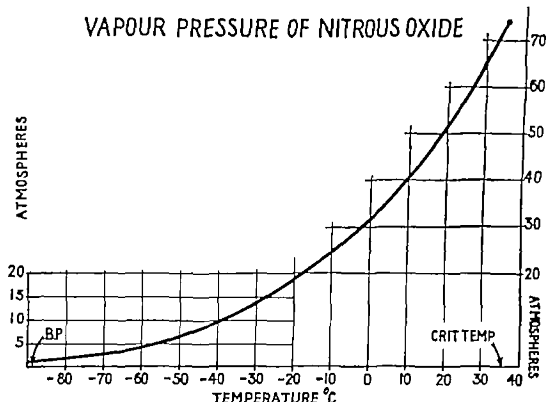


FIG. 45

There is common misconception that the pressure inside cylinder containing liquid nitrous oxide is always 750 lb./sq in. (5 atmospheres). The pressure of the vapour above the liquid nitrous oxide like that above any other liquid, varies with temperature. Fig. 45 shows that if the temperature of the liquid falls below −89 C. the vapour pressure falls below 1 atmosphere. Above this temperature the cylinder valve must be closed to prevent the liquid nitrous oxide boiling away At °C. the vapour pressure is 3 atmospheres. If the cylinder is left standing overnight at temperature of 10°C. the vapour pressure will be 40 atmospheres.

(By kind permission. From *Physics for the Anaesthetist* by Sir Robert Macintosh and Dr William W Mushin. Research directed by Dr Epstein).

thing that is not absolutely essential for quick visual assimilation should be left out. Economy in words is a basic rule in the making of charts, for instance, never write 'time in minutes' when the word 'minutes' alone is sufficient.

The stencils which have been described earlier in the book are quite ideal for the making of charts. Always choose letters which are big enough to be very easily read, and nine times out of ten the stencil selected will have letters which are slightly condensed. A wide alphabet, meaning an alphabet of square or squat letters, will tend to make a wide chart, with the effect of looking loosely put together.

More and more the results of research and medical practice are presented in the form of charts and tables, and it is worth spending time considering the best way to show these results. Some of the medical journals request that no lettering or figures should be inked-in on charts and diagrams for publication. These journals prefer their own printer to print all the lettering, and this, of course, makes for a pleasant uniformity throughout the publication. However when the artist puts in all the figures, labelling, etc. it should be done as neatly as possible with a definite plan in mind, such as the 'Vapour Pressure of Nitrous Oxide' (Fig. 45), where the curve rises slowly at the beginning and steeply at the end and the figures on the upright scale move from left to right. Figure 46 is a very simple chart: the parallel stippling was meant to convey a build up of sunshine and to be more interesting than just two curves.

In order to be accurate, curves and columns should always be roughed out on graph paper. If blue graph paper is used, the pencil lines can be inked over on the graph paper itself, as the blue grid is photographically invisible when making a line block and invisible, too, on a process plate which is the first step in making a lantern slide. Logarithmic scales particularly must be worked out on a grid paper and, having finished the pencil layout, this can then be placed under tracing paper or tracing linen and inked over or inked over on the grid paper itself, but only if this is printed in blue ink. When inking in numbers on an upright scale it is easier to start with the figure nearest to the scale line and work outwards: there is then no possibility of the numbers appearing cramped. This applies also to any caption or heading which should not stray further than a given point, or past a real or imaginary line. Accordingly to start with, it is best to begin stencilling where the caption should *finish* and work towards the *left*. Good arrangements and placings are easier for the practised artist, but each chart made is something learned towards making the next one. Inking-in a chart on tracing paper or tracing linen has the great advantage that the underlying rough may be moved up, down, or sideways in order to find the best place in which to put in the 'key' if there is one, the title and anything else which has to appear in the picture.

Manikins are another useful method for the visual presentation of a story for statistics and for warning do's and don'ts. There is a fund of information which can be shown by manikins, from the outline robot symbol commonly used for demonstrating the statistics of the common ills that befall mankind, to the more realistic figure shown in Figure 47 as facial expressions and gestures can be drawn.

Students have so much to learn in modern medicine, that it is desirable that the maximum amount of information should be presented in a condensed form which can be understood visually and quickly. Any visual aid which can be apprehended at a glance, is an asset to the student and teacher alike.

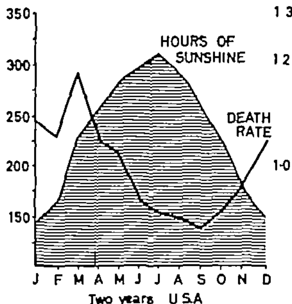


Fig. 46

This little graph is self-explanatory the upright scales need no explanation other than the figures. (By courtesy of Dr B. O. Scott.)



Fig. 47

Emotions as well as statistics can be conveyed by the 'mankin' figure. As a teaching aid it is often most effective.

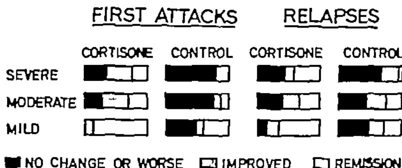


Fig. 48

A Histogram showing the effect of treatment of ulcerative colitis with cortisone in relation to the initial severity of the illness. (By courtesy of Dr Truelove and Professor L. J Witts).

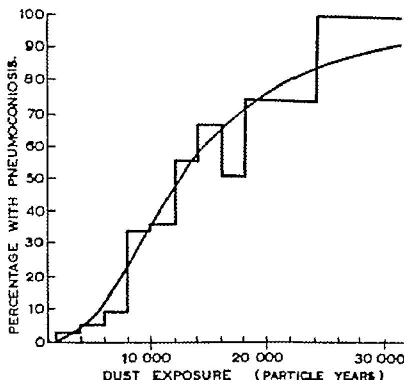


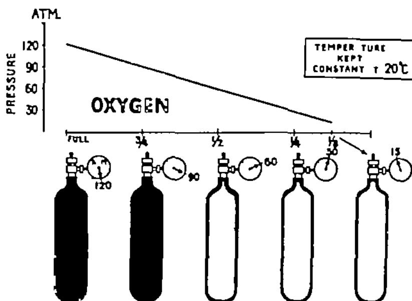
FIG. 49

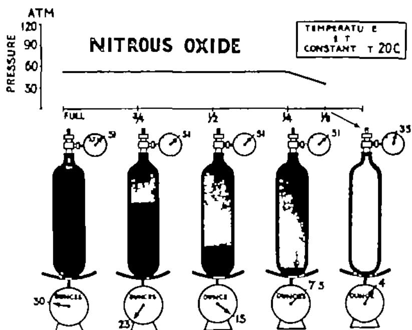
The relation between dust exposure, expressed in particles per ml. time, and the percentage of coal-face workers with radiological evidence of pneumoconiosis (hypothetical data). By courtesy of Professor L. J. Witts.

It is a golden rule in the making of charts and diagrams to make all lines just a little thicker than seems necessary, and even then an added half millimetre often gives distinction to the simplest diagram. Bold, firm execution is the secret of success in all illustrations of this type.

Figures 48 and 49 show entirely different types of charts, which contain the ideal amount of information for a lantern slide. As it is not always possible to make every picture fill the screen, it is better to have an elongated effect rather than that the material presented should appear cramped. For instance, Figure 53 would have been spoiled by trying to lessen the width.

Ideas translated into drawings or diagrams however simple, are always worth considering for use as illustrations. The artist will be fulfilling his role of visual educator to the best advantage if he is always willing to advise on the best way of presenting the information which has to be explained. The medical author and teacher may know exactly what he wants and how it should be done, but the artist can make suggestions, which will certainly be considered even if they are not always adopted.





Figs. 50 and 5

(By kind permission from *Physics for the Anaesthetist* by Sir Robert Macintosh and Dr William W Mushin Research directed by Dr Epstein).

Figures 50 and 51 show a chart combined with a diagram, and each presents its information in two forms and with the addition of colour. Each of these figures made a good lantern slide, but the line of the curve in each case should have been thicker. This is a good type of visual aid, but unfortunately the addition of colour to a schematic-drawing chart-combination of this kind is not possible in the average medical journal, as the cost of adding even one colour to any picture is considerable. Even in the best medical textbooks, the addition or otherwise of colour has to be considered very seriously. (See Chapter XI).

Figure 52 is an ideal type of simple chart both for publication and projection. When facts can be presented in this way they are indeed true visual aids.

The artist who spends a lot of his time preparing visual displays rather than illustrating operations, is certainly not wasting his time.

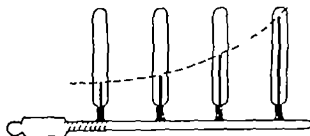


FIG. 52
Shows the rise in temperature along a heated poker
(By courtesy of Dr. R. O. Scott.)

The value of a medical illustration can hardly be assessed in terms applicable to other drawings. The clever advertisement may bring in hundreds of thousands of pounds. The new operation illustrated in great detail may save lives in countries where hitherto nothing so elaborate has ever been attempted.

FIG. 50
A cylinder when 'full' contains oxygen under a pressure of 120 atmospheres. The valve is opened and the gas allowed to escape; there is a progressive fall of pressure. When the pressure has fallen to 60 atmospheres the amount of gas within the cylinder has fallen, too, to half of what it was initially. A pressure reading at any stage gives an indication of the amount of oxygen remaining in the cylinder. As the density (represented by intensity of colour) decreases there is a corresponding fall of pressure.

FIG. 51
The liquid nitrous oxide and the density of the vapour above it is represented by intensity of colour. The temperature throughout the experiment is kept constant at 20°C., at which the pressure exerted by the saturated vapour over the liquid is 5 atmospheres. As the tap is opened gaseous nitrous oxide escapes and is immediately replaced by further vapour from the liquid. When the cylinder is half full the density of the vapour and therefore its pressure, are still the same. In fact these remain unaltered as long as any nitrous oxide exists in the liquid state. An accurate indication of the amount of nitrous oxide remaining in the cylinder can be obtained only by weighing the cylinder.
The horizontal line shows that the pressure of the vapour within the cylinder remains uniform until it is just less than quarter full. When the liquid is all volatilised the pressure of the gas within the cylinder begins to fall.

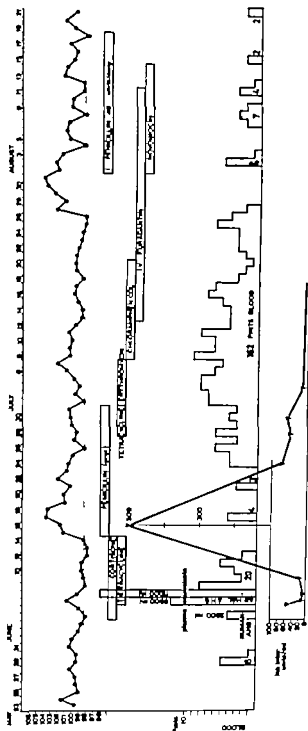


Fig. 53

This shows the detailed treatment of patient over three month period. The reduction is to | of the original size. A Ben Day Tint is used on the columns which show how much blood was administered.
(By courtesy of Dr B. O. Scott)

Chapter VIII

Techniques in Line Drawing

TO most of the readers of this book the phrase 'a line drawing' will suggest some object drawn in black ink on white paper. A line drawing can be easily reproduced by a line or zinc block, and printed as is nearly always the case on white paper. There is no intermediate or grey tone in a line drawing, although the illusion or effect of grey can be produced by ruling or drawing lines, 'hatching' or 'cross hatching' or covering areas of a drawing with dots of equal or varying sizes. The density of the 'grey' areas will be determined by the number of lines ruled or drawn, the thickness of these lines and the distance between the lines. This applies to dots also: the number and the size of the dots make either

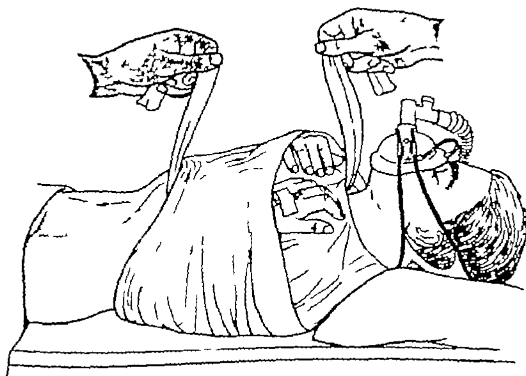


FIG. 54

Drawn for the Nuffield Department of Anaesthetics, Radcliffe Infirmary, Oxford. Reproduced by courtesy of Dr Mitchell.

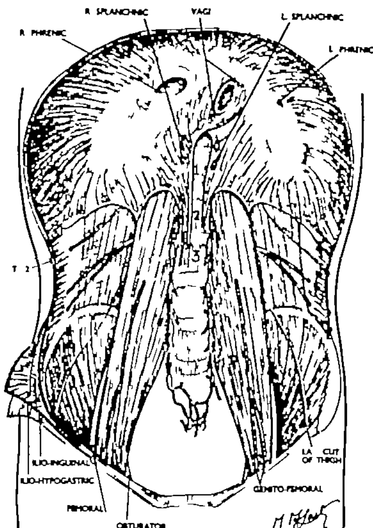


Fig. 55
The posterior abdominal wall showing the relation of the nerves. This was a key drawing for further illustrations of this region. (From *Local Analgesia, Abdominal Surgery* by courtesy of Sir Robert Macintosh and Dr R. Bryce Smith).

a light or a dark grey effect. For instance, a great many very small dots give a lighter grey effect than fewer larger dots.

It may be of interest here to describe briefly how a line block is made. (1) The drawing, which is strongly illuminated is photographed. (2) A print is made from the negative on to specially treated zinc, the zinc is coated with a solution of fish glue and ammonium bichromate, and the negative is placed in close contact with it (i.e. the zinc plate). (3) This zinc plate with the negative in front of it is next exposed to very strong illumination, and this makes the glue and ammonium bichromate insoluble in water but only on the parts of the zinc plate which were exposed to the light

These are the black areas of the original drawing which became white in the negative, allowing light to penetrate on to the zinc plate. (4) The zinc plate is washed, leaving on its surface an insoluble glue reproduction of the drawing It is then placed in an acid bath, and the acid dissolves the zinc in the parts *not* covered by the fish-glue solution, so that finally what is left is a *metal* reproduction of the original drawing made up of raised lines and areas corresponding to the black parts of the original drawing. (5) Lastly the zinc is mounted on a plaque of wood and is then ready for use. This, in brief is the method of making a line block, although there are many refinements of the blockmaker's skill which need not be discussed here.

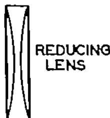


FIG. 56

From this brief description of how a line block is made the reader will no doubt appreciate why editors and publishers expect certain standards in the execution of any drawings sent to them for reproduction. Firm and clean lines are essential, however thin or thick they may be. The lines should have an even distribution of ink, as a thin line made with too little ink is liable to appear broken when made into a block. The acid bath is designed to remove the soluble portions of the plate, but it *can* also work sideways, so that hesitant or ragged lines may appear very much thinner on the final plate than they were in the original drawing.

As already stated, grey' does not exist. If he artist does not feel competent, or if it would take too long to cover any portion of a drawing by hand the grey' areas may be stippled or ruled with a Ben Day tint. On request a blockmaker will supply a chart of Ben Day tints, each of which has a number and it is sufficient to indicate by the number on the chart and a clear tracing paper guide attached to the drawing, which parts of the drawing should be stippled or ruled. Tracing paper guides should be pasted on to the back of the drawing and folded over the front to form a flap covering. Ben Day tints are to the blockmaker what Zip-a Tone is to the artist. Figure 54 shows a drawing in which the tone is Zip-a Tone It is described on p 56 In this picture, which illustrates a method of securing a patient's hands for an abdominal operation, the tone of the flesh could equally well have been made by the blockmaker with Ben Day tints.

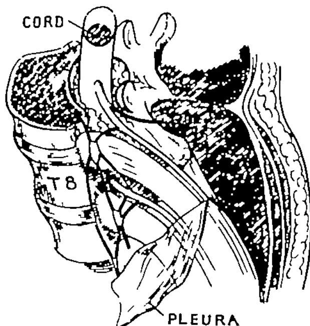
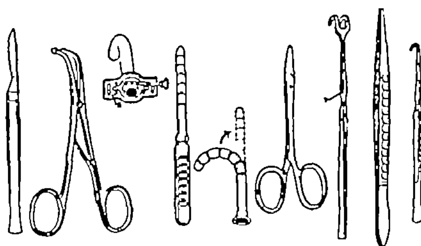


FIG. 57
The pedicle of the vertebra has been removed to show the communication between the extradural and the paravertebral spaces. (*After Macintosh and Mushin.*)



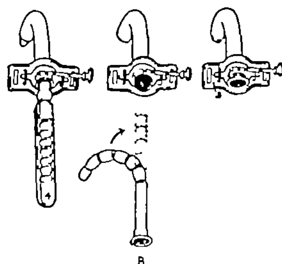


FIG. 58

The instruments for tracheotomy

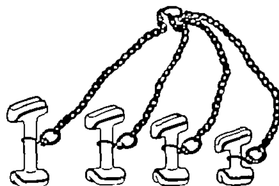
A and B

Scalpel.	6. Several pairs of artery forceps
2. Tracheal dilator	7. Retractors.
3. Tracheotomy tube.	8. Dissecting (conveying) forceps.
4. Introducer	
5. Inner tube.	9. Tracheal hook.

C and D

Illustrating mouth-props popular in hospital practice.

(From *Essentials of General Anaesthesia* by courtesy of Sir Robert Macintosh and Dr Freda B Pratt Bannister).





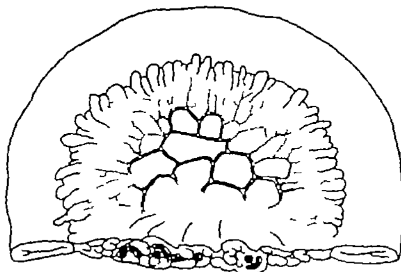


FIG. 59

A loop of intestine at seventeen feet. The vessels are seen with difficulty in the thick fat of the mesentery (By courtesy of Dr Guy Winston Horsley the C. V Mosby Company publishers of Horsley and Bigger *Operative Surgery* 6th Edition —after Monks

The labelling of drawings is described in the chapter on half-tone, and everything that applies to half tone drawings applies also to line drawings, the only difference being that all labelling in a line drawing is included in one block. For reproduction it is nearly always the width of a drawing which will determine the reduction and the artist should arrange his labels so that they do not take up more room than is absolutely necessary By ruling faint parallel lines at the top and bottom and on each side of a drawing, it will be seen where there is most room for placing the labels, and by arranging the majority of these at the top or bottom, rather than at the sides, the amount of reduction necessary is considerably less than if the labels are placed alongside the picture or indiscriminately (Fig. 55). It should be the concern of the artist to arrange the labels so that however many there are they do not appear crowded even if finally the labels are printed by the printer and 'patched in' by the blockmaker

Using this method, the artist draws in ink the 'leaders' that is, the lines which unite the descriptive word or number with the place indicated and the descriptive word or number is written in pencil. The pencilled labelling should be on a semi transparent overlay pasted to the back of the drawing and folded over the front. This provides something from which to check the labelling, whereas faint blue pencilling on the drawing itself is covered by the patch and no copy is left for checking. One point to bear in mind is that it is essential to make the labelling large enough to be very easily read *when reduced*, but not so large that it dwarfs the illustration. A reducing lens is invaluable to anyone preparing illustrations for publication (Fig. 56) In a drawing which has a very great number of labels the 'leaders' should not cross one another although they

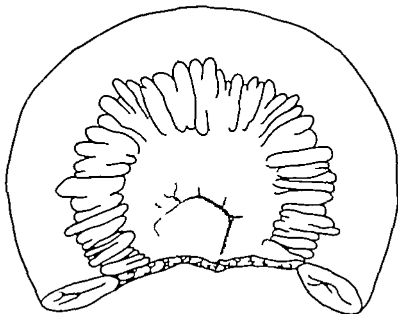


FIG. 60

A characteristic loop of intestine at twenty feet. The mesentery is opaque and large fat tabs are present. The vessels are barely visible. (By courtesy of Dr Guy Winston Horsley the C. V Mosby Company publishers of Horsley and Bigger *Operative Surgery* 6th Edition —after Mooks).

may be angled where necessary Symbols or numbers may be used with a key in the caption. Just as blue pencil does not show in a line block, different shades of white will also be invisible, so that the labels can be printed on gummed paper This is a very good method as, before they are stuck down, they can be moved about easily until the best arrangement is found.

Soft tissues and also semi transparent structures can be illustrated as in the turned back flap of tissue lining the ribs in Figure 57 This is a drawing made from a dissection in the post morten room.

When surgical instruments have to be shown either singly or grouped as in Figure 58, an ink drawing is sometimes better than a photograph. If the reader will turn back to Fig. 2 it will be seen that the instruments have changed little over the centuries. There are, *however* plenty of good photographs showing instruments arranged against a black or grey ground but the cost of reproduction is greater than for a line block.

A line block is the cheapest of all blocks to make, and the variation which may be obtained from the simple drawing of a few lines to the almost half tone effect achieved by dots and very fine lines, is almost limitless

Figures 59 and 60 illustrate absolute simplicity achieved by fundamental knowledge and a skilful handling which can be portrayed only by an artist capable of conveying form in one or two lines. Until these drawings are examined closely one does not notice that there is no gradation of line, apart from the dotted portion, and yet the characteristic look of intestine, the fat and the mesentery (the tissue by which the gut is held in place) with its hidden blood vessels are all very clearly indicated. These drawings look three-dimensional yet they are completely simple. By suggesting the blood vessels, rather than drawing them, the attention is not drawn away from the

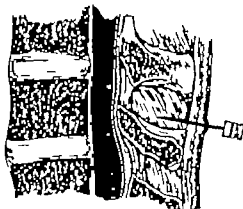


Fig. 61

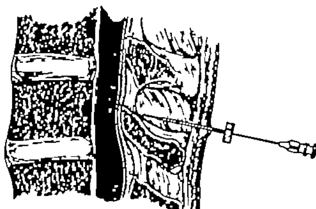


Fig. 62

Fig. 61
After skin wheal has been raised, the point of the director should not be pushed in for more than an inch.

Fig. 62
When the director is in place the stilette is withdrawn and replaced by the lumbar puncture needle, which is pushed in tentatively

Fig. 63
If bone is encountered en route to the dural sac, the needle is withdrawn until it lies within the lumen of the director. The aim of the director is altered, and another attempt at hitting the target is made by pushing in the lumbar puncture needle gently

Fig. 64
When the target is reached, cerebro-spinal fluid drops from the needle. The yellow structure is the ligamentum flavum.

Fig. 65
The basic drawing from which the four figures 61, 62, 63 and 64 were made. The track of the needle has been left blank.

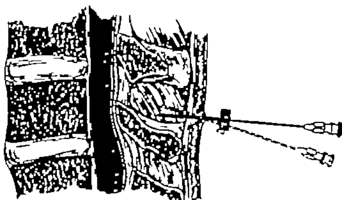


Fig. 63

Figures 61-65 from *Lumbar Puncture and Spinal Analgesia*, by courtesy of Sir Robert Macintosh.

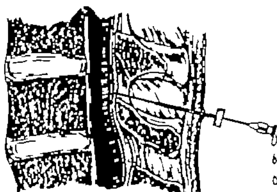


Fig. 64



Fig. 65

globules of fat which is an important factor in recognising which part of the small bowel one is looking at. The cut ends showing the lining bulging out are perfect.

SERIAL ILLUSTRATIONS

When a procedure has to be illustrated serially in a number of views, such as the lumbar puncture series shown in Figures 61-64 the best thing to do is to make one basic drawing without needles (Fig 65) This is then photographed and the artist positions the needles on the prints, of which there can

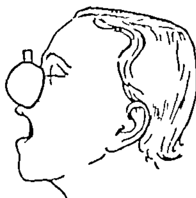


FIG. 68
Keep the chin up and the nose-piece down advice given to beginners in dental anaesthesia. (*Right*)

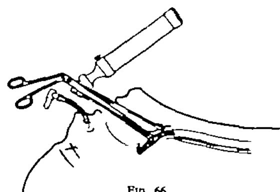


FIG 66
Should manipulation of the proximal end of the tube be unsuccessful the distal end is packed up with a pair of Magill' forceps and guided into the larynx.

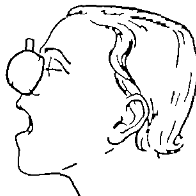


FIG. 67
If the lower border of the nose piece is too high the nose is blocked. (*wrong*)

Figures 66, 67 and 68 from *Essentials of General Anaesthesia* by courtesy of Sir Robert Macintosh and Dr Freda B. Pratt Bannister

be any number each one of course identical. Much time is saved in this way for although the original drawing in this case is a simple one, it would have taken considerable time to reproduce it accurately four times by hand. Moreover as the basic pictures are identical the eye is not distracted by any variation save that of the needles. The addition of one or more colours is undoubtedly an asset for line drawings and can be used both to add emphasis and to differentiate structures By using orange for the endotracheal rubber tube in Figure 66 added definition is achieved in what is after all just a thumb nail sketch. The simplicity of line drawings should appeal to all who teach, whether by writing or with lantern slides in the lecture theatre.

Illustrating 'Wrong' and 'Right' is very simply shown in the next two Figures, 67 and 68 The patient is about to have a dental anaesthetic and is sitting in the dentist's chair Had this patient been photographed, the difference between the 'Wrong' and the 'Right' position of the mask, so slight in actual fact would hardly have been apparent. In this particular case a drawing is a better illustration of a possible error than a demonstration on an actual patient.

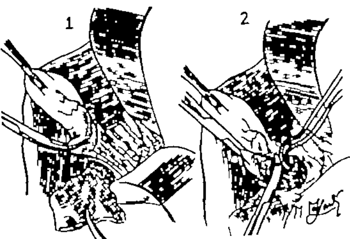


FIG. 69
The first steps in the operation for the removal of the gall-bladder (Cholecystectomy).

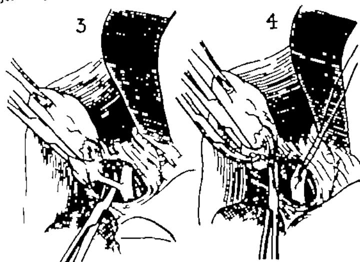


FIG. 70
The cystic duct is now visible, and it is then divided, two further steps in this operation.

OPERATIVE PROCEDURES

Operative procedures too, can be shown very clearly in ink. Fat and muscle can glisten and retractors shine when drawn by the expert. In medical books coarse ink drawings seem out of place. When looking at the illustrations in a medical book the reader should not have his attention distracted by the drawings the reaction the artist should try to achieve is, 'Yes, it is just like that' He should concentrate on showing clearly simply and realistically what is wanted (Figs. 69 72). Tricks to catch the eye, if they are not tricks to emphasize the point under consideration,

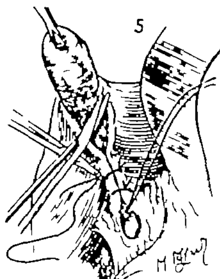


FIG. 71

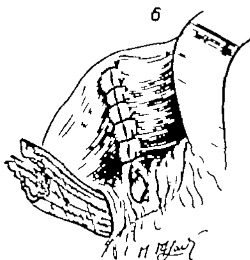


FIG 72

FIGS. 71 and 72. The final stages of the operation. The raw surface of the liver is stitched with interrupted sutures. Finally a corrugated rubber drain is placed within the wound. Each of the drawings in this series was reduced by half.
(By courtesy of Mr. Rodney Maingot.)

should be avoided. Nevertheless, subtle emphasis and selection are indeed the fundamental differences between the artist and the camera.

MATERIALS FOR LINE DRAWINGS

Most medical artists will have their own 'pet' tools in the form of pens and papers. These vary considerably and are not of great importance. It is sometimes said that "Ether is as safe as a London bus." For the author the same advantages apply to Scraper Board! This is a board sprayed with a covering of chalk, giving a hard, smooth, white surface. Ink lines may be scraped off, others put in and again scraped off, and so on until the chalk surface is exhausted. Care should be taken when scraping the surface to do so smoothly and not with a too pointed instrument. The gentle curve on a No. 22 scalpel blade is an ideal scraping instrument.

PENS

The choice of pen depends to a very great extent on the type of drawing which has to be made. There are, too, a great variety of nibs of different widths and flexibility. Some artists still favour reed pens which are flexible and sympathetic to use. It is a fallacy that all line drawings should be made with a 'mapping' pen, which draws fine lines and is almost rigid. There are artists who use a fine brush rather than a pen, and most people agree that the pen used should be the result of experimenting with several types. For drawing really thick lines the Graphos (Fig. 23) with its large variety of nibs is ideal, as the sump for holding ink makes it possible to draw for long periods without refilling. For really broad lines of half an inch or more felt nibs are exceedingly useful. A very large range of pens and nibs is stocked not only by artists' colourmen but also by the large stationers.

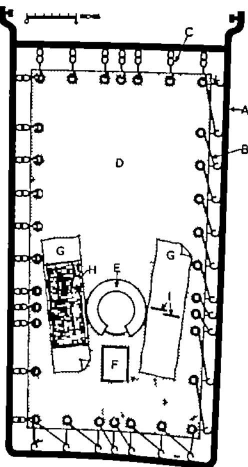
SCRAPER BOARD

If the hand is sure, the touch light, and the pencil soft enough (a 4B or 5B being ideal), drawings may be done directly on to Scraper

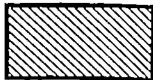
Board. A drawing can be transferred to Scraper Board by placing carbon paper under it and outlining the work with a hard, finely pointed 2H or 3H pencil An alternative method is to rub soft lead pencil on to the back of the drawing, drawing over the lines of the original again with a hard (2H or 3H) pencil. This leaves a soft pencil ghost' drawing on the Scraper Board. Possibly more labour-saving in the end is the method of drawing the original picture on thin typing paper and transferring this on to the Scraper Board in the same way as a carbon pencil drawing is transferred on to Ross Board (see Chapter VIII) Poster colours may be used on Scraper Board, but should not be used too wet, unless it is quite certain that nothing will have to be altered. Wet colour sinks into the chalk surface, which is the reason for using poster colour rather than water colour although the latter may be used.

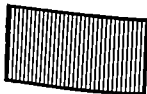
BRISTOL BOARD

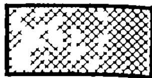
Bristol Board is another favourite for line drawings. It is made in many sizes, Foolscap, Medium, Royal and Imperial and in 2 sheet thickness to 6 sheet thickness. Alterations are made with Process white or by scraping out. Process white is a white paint similar to Chinese white water colour Chinese white should never be used as it photographs grey To correct mistakes the underlying ink is covered with Process white, which is soluble in water and when dry is completely opaque. It is therefore necessary that the black ink used



ZIP-A-TONE







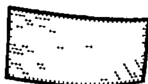


FIG. 73
Zip-A Tone is illustrated here, but there are two British equivalents PRESTAX and PLASTITONE which may be obtained from A. Webb & Partners Ltd., 96 Broadway Westminster London, S.W The drawing of the bed is by Mr. Peter Cull.

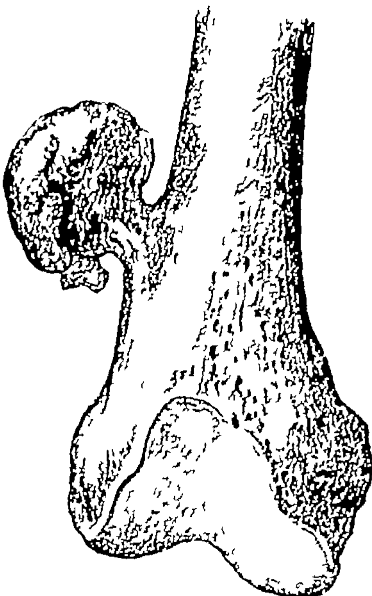


FIG. 74
A bony protruberence on the side of the femur just above the knee joint. Drawn from specimen in the Museum at Kings College Hospital. The reproduction is almost life-size to demonstrate the grain in the paper. As an illustration of the protruberence it would have been reduced by half.

should be waterproof otherwise corrections or alterations with Process white will run into the ink. The artist should not attempt to cover large areas of ink with Process white.

On the whole, alterations on Bristol Board are best made by scraping out. It is always worth while buying the best black ink, which will flow freely and evenly. It is better, too, to buy two small bottles rather than a large one as it is inevitable that a pen or brush will deposit chalk from Scraper Board, or dust and grit from Bristol Board and paper into the ink when dipping in the pen or brush. It is not extravagant to throw away the last third of the contents of all bottles of black ink. Line drawings on tracing paper or tracing linen or on Kodatrace photograph and reproduce very well and the surface is easy to work on. Drawings on tracing paper can be photographed directly on to a duplicating stencil. For work of this type the lines should not be too thin. No one should attempt to make a final drawing in ink on any surface which has been much drawn and rubbed on. When working on any surface other than tracing paper the transfer is the cleanest method of providing the underlying 'ghost' drawing on which to work.

ZIP A TONE

Zip-a tone consists of sheets of cellophane, ruled on one side with lines, cross hatching or dots, and having an adhesive undersurface. The transparent Zip-a tone sheet should be laid on the surface to be covered and finger pressure

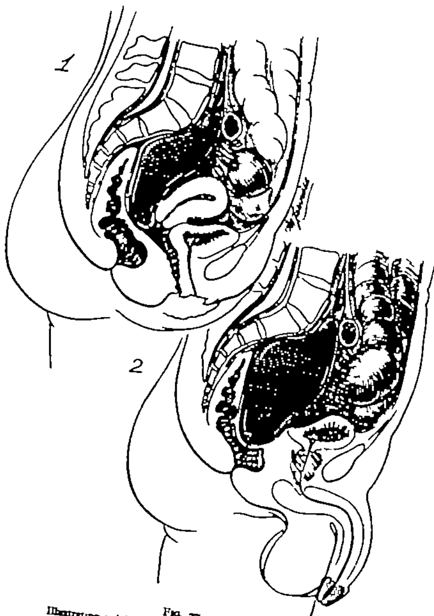


Fig. 77
Illustrating pelvic abscess in the female and the male pelvis. (By courtesy of Mr Rodney Maingot.) N.B. The adhesions and the fluidity of the abscess cavities are very well shown.

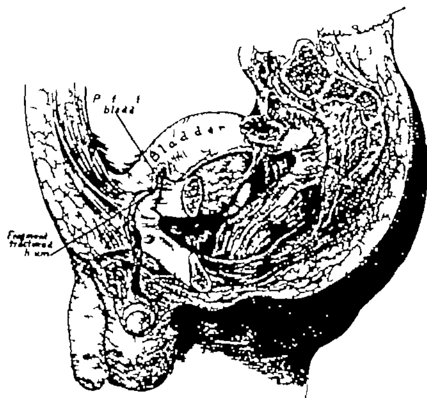


FIG. 78

Male aged years. Pelvis fractured by overturned automobile. In few hours small quantities of blood stained urine with oedema of scrotum and evidence of extravasation of urine into soft tissues led to diagnosis of rupture of the urinary bladder. Operation demonstrated puncture of bladder from spicule from fracture of the pubic bone. Closure of bladder defect. Recovery

(By permission of *Surgery Gynecology and Obstetrics*).

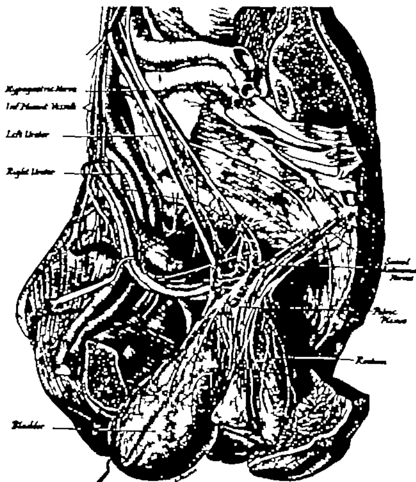


FIG. 79

A dissection showing the distribution of the hypogastric and pelvic nerves (Woollard and Norrish). The left innominate bone has been removed and the left pelvic plexus is seen from the lateral aspect as it lies in relation to the lateral wall of the rectum. Fibres pass from the pelvic plexus on to the rectum, forward to the prostate and bladder, and upwards on to the lower part of the ureter The para-sympathetic nerves are here clearly seen passing forwards from the 3rd and 4th sacral nerves. (By permission of the *British Journal of Surgery*)

the salaries earned by medical artists are so poor Many people may have seen some of Mr Poulton's drawings, for instance that of the composer Vaughan Williams (Fig. 80). Here is seen the same mastery of line as applied to the anatomical study



FIG. 80
Ralph Vaughan Williams, O.M. Drawn for the *Radio Times* by T. L. Poulton.

PROOFING PAPER

This paper provides an alternative to Scraper Board and Bristol Board. The artist draws with a 5H or 6H pencil instead of a pen. It is not possible to rub out on this paper but the flow of line, which is so much easier when using a pencil compensates for the fact that erasing is difficult. Figure 81 is an example from Mr Donald, in Glasgow who has obviously mastered this technique.

If medical artists can, by the integrity and clarity of their pictures, contribute something to the teaching of the medical profession, then students will have more time to assimilate the mass of material now required for a medical degree.

FIG. 81
One of a series of drawings to illustrate book on *The Relationship and Behaviour of Rats.* (By courtesy of Mr Gabriel Donald.)

Chapter IX

Techniques in Half-Tone Drawing

THE term Half tone covers all drawings made in pencil, charcoal, chalk, water colour and wash drawings done in sepia or black ink, or with powdered black lead. It includes also oil colour monochrome. A pencil or charcoal drawing might appear to be a line drawing, in that it may be a drawing composed of lines only with no tones, but in order to reproduce it for publication the half tone process is necessary This process necessitates the use of a screen of dots placed between the camera lens and the drawing, when a block is being made. Look at any photograph in a newspaper with a magnifying glass and it will be seen that the picture is broken up into a series of dots. Screens are selected according to the quality of the paper on which the illustration will appear 60-80 lines (composed of dots) to the inch for newsprint, and for scientific subjects a screen of 133 to 150 lines to the inch, is a usual choice. Half tone screens are made from two sheets of plate glass, each ruled with parallel black lines of equal width, the black lines being equal to the white space between the lines. The two sheets of glass are then cemented together so that the lines of one sheet are at right angles to the lines of the other sheet. The crossed lines form a mesh in which the area covered by the black lines equals the white spaces or mesh of dots (Fig. 82).

REPRODUCTION OF HALF TONE

Before describing some of the half tone methods of making a drawing a few words on the reproduction of half tone illustrations may be helpful. In a drawing not intended for publication the artist may draw exactly as he pleases, but with reproduction in mind there are several points to remember The first is that any half tone screen will place dots over the whole picture, *including* the highlights, however brilliant they may be. A very fine screen will give more detail but it also places more dots in the highlights, for the size of the dot is constant throughout the picture. It is possible for the engraver to remove the dots from the highlights by hand, but this adds to the expense and makes the block more difficult to print. Therefore it should be remembered that all reproductions have a slightly flattening effect, when compared with the original drawing. The artist should not, however try to produce a contrasty picture like a contrasty print, for contrary to the general view these do not reproduce well, since the lightest of the intermediate tones can be so faint as to be lost altogether The aim should be to produce richness, really dark areas, and well-defined intermediate tones the printed result will not then be disappointing.

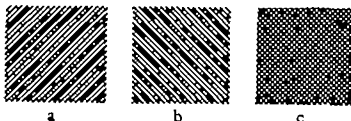


FIG. 82
and b are cemented together to make c.

LABELLING

Perhaps it should be emphasized here that any ink line drawn on a half tone drawing will be reproduced by dots. *Therefore, in labelling* a half tone drawing two methods are available. The artist may print in ink on the structures which require labelling, or the printing may be within the margin of the drawing but not actually on the various structures themselves. The labelling and structures are united by a line known as a leader' which may be thick or thin or a broken line of black or white. This should be clear but unobtrusive.

In the second method, the artist draws in the leaders on tracing paper or Kodatrace, having first put a + sign at each corner of the paper on which the drawing is done so that the tracing paper also having the + signs will be in exact register with the drawing. The label ling may then be printed by the printer on paper with an adhesive back and attached to the appropriate leaders and a separate line block made. The half tone and the line block are then united to make one picture. *This is the usual procedure for complicated* anatomical drawings where a great number of labels are used, as for example in Fig. 99.

When a drawing is photographed for making a block it is illuminated by very powerful lighting, and any defects will be clearly seen. With highly technical drawings such as medical illustrations, the blockmaker may be unaware of these defects, but had the artist looked at his picture in bright daylight or under power ful artificial light such blemishes would have *been clearly apparent before his picture* reached the blockmaker More co-operation between artist and blockmaker is essential for really first-class reproduction to be assured. Sometimes it is impossible for the blockmaker to tell which is the top of the picture he is photographing, if this is highly technical or elaborately anatomical. It is easy to write TOP on *all* drawings.

REDUCTION

The size of a drawing for reproduction is important. That reduction improves every drawing is a statement which is much too sweeping, for over reduction in an effort to save space can be most disheartening in its results. Always try to find out and bear in mind the size of your page, or the width of a column, if the picture is for a journal of one or two columns and is unlikely to be given more than a column width of space. To repeat from the previous chapter it is nearly always the width of a drawing which determines the reduction, and should there be any labelling attached, then this too will be included in the total reduction if these labels project beyond the margins of the drawing. It is a question of individual taste whether or not a half tone drawing should be labelled by the artist. If

this can be done sufficiently neatly it is the writer's view that it should be done by the artist. Medical publishers sometimes complain that the illustrations given to them are often spoilt by indifferent and even bad labelling.

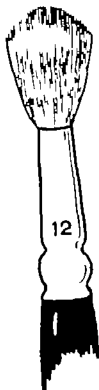
Instructions about reduction should be clearly indicated. *It is not enough just to* write 2/3 on a drawing, this may mean either that the drawing is to be reduced *to* 2/3 or *by* 2/3 which would mean that in the first instance it would be 2/3 of its original size and in the second 1/3 of its original size. Drawings can be prepared for uniform reduction which results in economy in blockmaking. For instance, all those requiring reduction to 2/3 are made in suitable groups, and those requiring reduction to 1/2 are also grouped. A very clear method is to draw a line along the base of the drawing indicating the left and right hand margins by an arrow head and in the middle *of this line to write the size, say 4½ inches,* which will then determine the amount of reduction required.

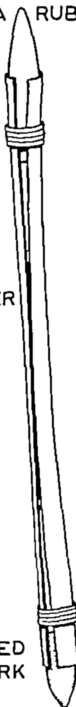
ROSS BOARD

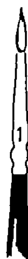
Ross Board is a chalk surface paper adapted especially for medical drawings by the late Professor Max Brödel. At the time of writing no British board has as yet quite the ideal surface of the American board. The equipment for Ross Board drawing (Fig. 83) is easily obtainable a large hog hair painting brush, No 20, for 'stabbing' and a large beaver brush, No. 12 or No. 15 for 'laying in the tone and two or three small water colour brushes for finer details, are among the first essentials. Wolff carbon pencils 3B, B, and HB, and the kind of india rubber that is firm and may be sharpened into a point on sandpaper and held in a holder are also basic needs. A piece of cork shaped like the end of a pencil and held in a holder is another essential. A medium fine sandpaper block or piece of sandpaper is also required for sharpening the pencils, the rubbers and the cork. It will be found that a No. 22 *scalpel blade, as mentioned* in the preceding chapter will be the best instrument for making the final highlights. Ross Board may be ordered from the Charles J Ross Company 1525 Fairmont Avenue, Philadelphia, U S.A. It works out at about six shillings for a sheet 14 × 11 inches.

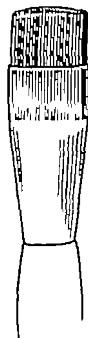
The Ross Board technique sounds a little laborious and complicated, but it was designed for speed, and with practice this should be attainable. Using a 3B carbon pencil make a drawing of the subject when it is certain that every detail on this drawing is correct it is ready to transfer to the Ross Board. Should many alterations be necessary on a drawing, it is better to re-draw over the first effort on thin *cartridge paper or non-greasy tracing paper* than to try to rub out and alter extensively on the original drawing. A much rubbed-on drawing can never be successfully transferred. The drawing to be transferred is placed face downwards on a sheet of paper or on a drawing pad. A drawing pad makes a better base on which to transfer a drawing than a piece of paper pinned to a drawing board. The drawing must be very carefully clipped to the drawing pad, and thereafter the back of the drawing rubbed over with a penknife handle or the handle of a pair of scissors. Use as much pressure as possible without actually stretching the paper or causing it to move. The slightest movement will make a fuzzy or double image transfer and this is almost useless for transferring in its turn to the Ross Board.

Unfasten the original drawing, and a transfer or negative drawing almost as black as the original from which it was made should then be seen on the pad. This negative draw









No 22
SCALPEL
BLADE

Fig. 83

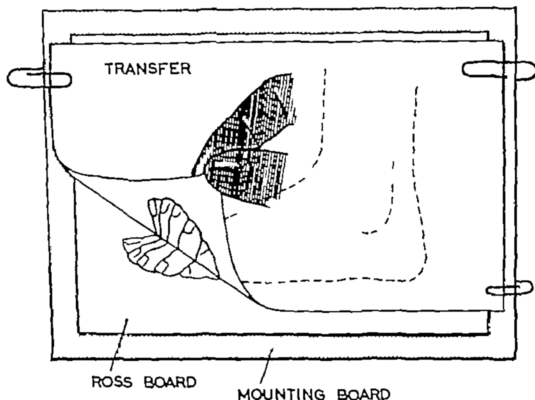


Fig. 84

ing is now in its turn transferred to the Ross Board surface. Place the negative drawing face downwards on the Ross Board, and fasten it with at least three paper clips to prevent any movement. The Ross Board used for any drawing, however small, should always be mounted on mounting board before use. This is necessary as otherwise there is the possibility of cracking the delicate chalk surface, and a crack in the chalk will inevitably show through any drawing.

The negative drawing, now clipped to the Ross Board, is transferred to the board with the pressure of a thumb nail only (Fig. 84). Rub gently but as firmly as possible first across and then at right angles to the original rubbing strokes. In this way every line and all the tone on the negative drawing is transferred on to the chalk surface of the Ross Board. Lift up one corner of the negative drawing until a portion of what is underneath can be seen, apply more thumb nail pressure, look again, and, if any more dye has come off then enough rubbing has not yet been done on the back of the negative drawing. When satisfied that all dye has been transferred from the negative drawing to the Ross Board surface, unpin the negative drawing, and there will be the preliminary ghost' picture from which to work.

With an HB carbon pencil sharply pointed, line *up the main structures of the drawing and*

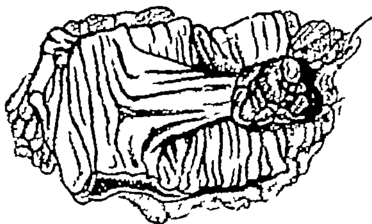


FIG. 85
The carbon pencil drawing of an isolated polypus of the intestine.

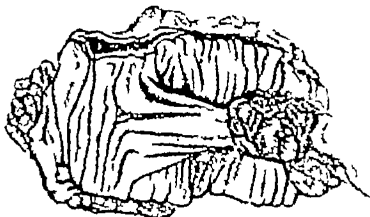


FIG. 86
The transfer or negative drawing made from the picture above.

any instruments. Now take the large hog hair brush and gently stab from the margin of the drawing inwards towards the centre, brushing the tone with short gentle strokes into the surface of the Ross Board. Too vigorous stabbing will give a shiny surface which is difficult to work on. Next make a little carbon pencil dust or 'tone' by sharpening a 3B carbon pencil on a piece of sandpaper and shaking the dust off the sandpaper on to a clean piece of white paper

Now take the large beaver brush and lay on the tone, shaking it on and gently blowing off the surplus rather than working it in. The next step is to work up the darkest parts of the drawing and the darkest tissues. The 3B carbon pencil accentuates these areas and should be smoothed over with the sharpened tip of the cork held in the holder Small areas of tone may be worked in with a small paint brush. It is generally accepted that for right handed people the light should come from the top left hand corner and if this is borne in mind for all drawings time is saved, as it is soon learned how light affects fat, hollows, bulges, muscles and vessels, whatever their direction and variation in shape.

When the form and relation of tone in the drawing looks sufficiently well balanced, pick out the broad lights with the pointed rubber held in the holder like the cork. The best rubbers for this purpose used to be the French Nigrivorine No. 5 but these have not been available here recently American Soap rubber is excellent, but difficult to obtain because of the dollar problem. British artists find there are hard types of india rubbers on the market which are quite satisfactory Typescript erasers are not suitable, as they are liable to scratch the delicate chalk surface. Figures 85 to 88 demonstrate the steps in this technique. Figures 85 and 86 show the carbon pencil drawing and the transfer. Figure 87 is the Ross Board drawing *before* the highlights are put in. Figure 88 is the finished picture.

When the drawing looks 'finished' take a No 22 scalpel blade and pick out the lights. Do not be too lavish with these 'lights' The temptation is almost irresistible at first, but a more mature effect is achieved by following Professor Brödel's advice, "Be stingy with your lights. The placing of highlights on a drawing is usually the final step in the making of a picture and it is important to give this careful thought. In general, the main high lights should be on or around the centre of interest. The eye should never be led away from the focal point to glistening fat or instruments which probably play an unimportant part in the drawing. Close inspection of the figures shown in this chapter demonstrates this point. Indian ink may be used for stitches, whether they are of silk, fine catgut or nylon. It may be used, too, on instruments or on blood vessels, and occasionally on other structures of the body which demand very definite contrast.

Ross Board drawings can be fixed with 90° alcohol or other fixing solution. A word of warning is necessary however before this is done as it is almost impossible to alter a drawing that has been fixed. Fixed or otherwise, it makes no difference from the point of view of reproduction. When used as records only the Ross Board drawings should be covered with thin cellophane, cellulose acetate, or Morane adhesive dry mounting skin.

This water-clear Plastic Skin is non adhesive in the cold but will firmly adhere to photographs when inserted into a Dry Mounting Press at temperatures used for Dry Mounting.

The operation is as follows

1 Remove interleaving paper place the

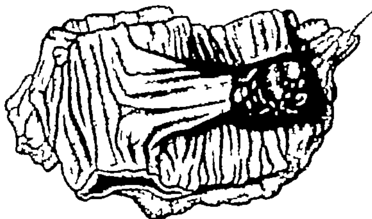


FIG. 87
The Ross Board drawing almost finished and ready for picking out the high lights.

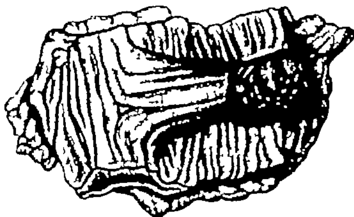


FIG. 88
The finished work, by courtesy of Mr Elliot Smith.

film on one or both sides of matt or semi matt photograph or drawing.

2. Put into press under cold chrome zinc, cover with pressure board and press for 15 seconds.

3 Remove and smooth out air bubbles.

4. Return the print and chromium zinc to press (without pressure board) and press for 2 minutes.

The method is simplified by using two chromium zincs, thus enabling the zinc used on the first pressure to cool thoroughly prior to using again. The finished product is completely protected against water dirt, oil and various chemicals Fading and crumpling are prevented. Very large photographs can be glazed without difficulty by this method. Morane' Super Adhesive Skin is available in glossy polished finish in gauges 0015 003 and 001 thickness, and in 002' 003 and 004 in matt finish.

When making a large drawing with several stages, the parts of the picture not being worked on should be covered with clean paper Always use clean paper on which to rest the hand as any grease will sink in and spoil the chalk surface, and there is no way in which this can be remedied.

Figures 89 90 and 91 are drawings of operation techniques in what photographers call 'high key' This means a picture with little contrast, relying on delicacy of presentation for its interest. Each of these drawings has a pearliness and appears relaxed and extraordinarily life like. The balance of tone is just right, and the comparatively dark tone of all the fat in relation to the other tissues is another point to note. Close observation will reveal that there are not many highlights on the fatty globules in spite of the realism. A photograph of such a wound would show many more brilliant lights, with the consequent distraction of the eye from the essential stitches in the muscles in this particular method of strengthening the wall of the abdomen.

In Figure 92 the use of Ross Board for cysts is well shown. Inside the head are three cavities known as ventricles, the third ventricle being the most inaccessible, as it is furthest from the surface of the brain. The pearl like cyst of the third ventricle in Figure 92, seen below the cut and retracted surface of the brain is glistening and deep. In spite of its brilliance it has remained at the bottom of the hole. This is achieved by maintaining the correct perspective of the brain surface, which is much more difficult than it appears to be. The actual tone is simple, but by correctly placing the highlights on the brain surface, the solidity of the whole is assured, and the accentuation of certain anatomical landmarks makes it even more sure that the cyst will stay where it should be, in the middle of the head. See Chapter V Compare Figure 92 with Figure 39

Figure 93 is a graphic 'warning' illustration, and Ross Board gives a very definite sense of realism. The interest is concentrated round the rubber tube, and although all the contents of the abdomen which are shown are quite clear and realistic drawn in this way (low key) they do not distract attention away from the 'warning' the picture gives.

Figure 94 shows a post mortem brain reconstructed in a child s head as it would have appeared in life. The huge translucent cystic area is clearly shown, and the perspective of the brain surface is beautifully drawn. The head, contrasting as it does with the dark background, makes a very satisfying picture.

*Obtainable from the Adhesive Dry Mounting Co Ltd., 26 Stamford Street, London, S E.

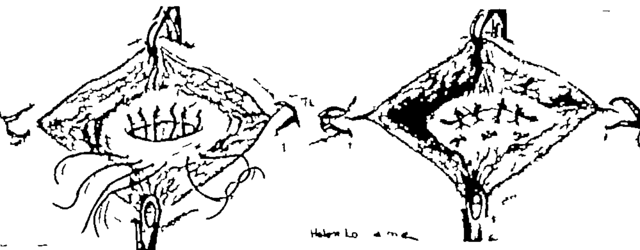


FIG. 89

The repair of the abdominal wall by Mayo method. Mattress sutures have been passed.

FIG. 90

The mattress sutures have been tied, and the resulting overlapping lip of fascia is fastened down by four interrupted sutures.

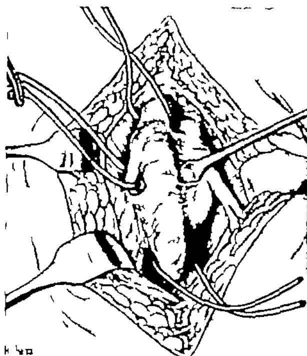


FIG. 91

The field of operation is ready for the removal of blood clot from the femoral artery. Note how the lines made by the rubber tubing in this picture and the sutures in Fig. 89 give depth to the wound.

Figures 89, 90, 91 from *Emergency Surgery* by courtesy of Mr Hamilton Bailey

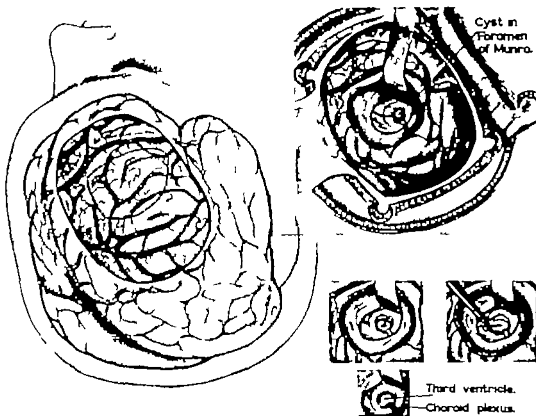


Fig. 92

These drawings show an operation on the brain for the removal of cyst situated deeply within the head. On the left the brain is shown in its relation to the head, and the extent of brain tissue which was removed is outlined by broken line. In the next picture the brain is held back with retractor to show the glistening cyst. Four burr holes in the skull indicate how the flap of bone cut out of the skull was turned back to gain access to the brain. The three close-up views demonstrate the removal of the cyst and the cavity where it lay.

(Drawn by Miss Audrey J. Arnott for the Department of Neurological Surgery, Radcliffe Infirmary, Oxford).

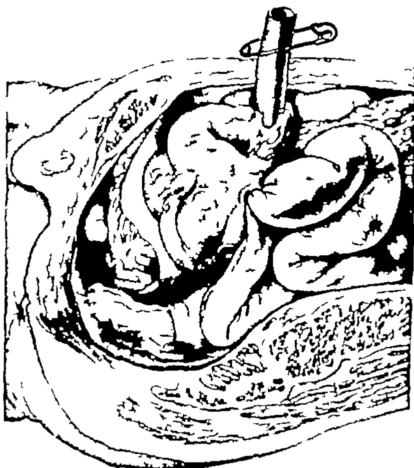


FIG 93

The menace of an unattended drainage tube reaches its zenith in the greatest indication for its intelligent use. Note the coils of small intestine clinging to the tube, and portion of coil becoming sucked into hole in the tube. Who can wonder that intestinal obstruction is imminent.

(From *Emergency Surgery* by courtesy of Mr Hamilton Bailey).

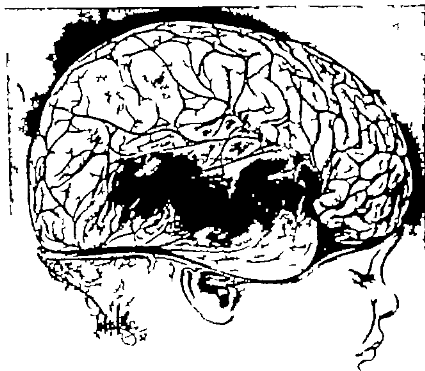


FIG. 94

The fact of drawing this brain inside the head shows not only the pathology but that the patient was child. The brain was not greatly enlarged although it is clearly abnormal above the cyst. This brain drawn or photographed alongside six or twelve inch ruler would not produce such comprehensive effect. (By courtesy of Miss Dorcas Hager Baltimore.)

The placing of the lights on the brain surface is well worth careful study especially if there is an actual brain specimen available with which to compare this drawing.

LEAD PENCIL

Figures 95 96 show two extremely competent and pleasing pencil drawings by Mr Charles Keogh. Here certainly is knowledge and mastery of technique allied to produce perfect illustrations. What a superb medical artist Mr Keogh would have made had he not already been a surgeon!

Figure 97 demonstrates a point made earlier *i.e.* that a drawing composed only of lines may have to be reproduced by a half tone block the effect is due to the removal of the half-tone screen (dots) from all the white parts. Each pencil stroke must have been painted over with a 'resist' by the engraver and the background etched away which is rather a



Fig. 95

A close-up view of tonsillectomy showing artery and veins entering the hilum of the tonsil, looked at slightly from one side.



Fig. 96

The paratonsillar vein adheres to the tonsil as it is dragged from its bed with Denis Browne forceps, viewed from in front.

(Figures 95 and 96 from Pye's *Surgical Handicraft* by courtesy of Mr Hamilton Bailey).

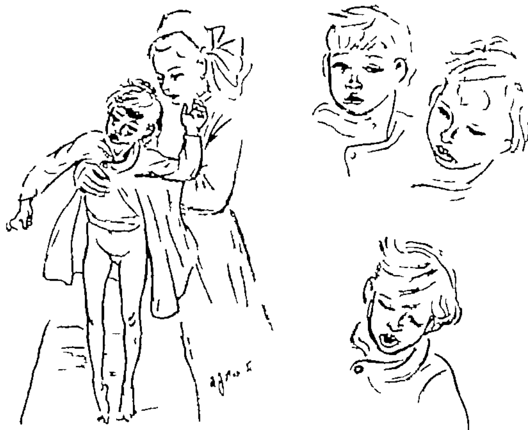


FIG. 97

These pencil sketches show patient in the ward for treatment of congenital choreo-athetosis, the body and limbs make continuous jerky movements even when the little girl is asleep.
(Drawn for the Department of Paediatrics, Radcliffe Infirmary Oxford).

costly process. The ordinary half tone process would have produced rather flat pictures. Lead pencil is not recommended for this reason If pencil is to be used, a carbon pencil gives a better black line and is easier to photograph and reproduce.

WASH DRAWINGS

Ross Board is definitely not the only medium popular in the United States and Canada for medical drawings. Figure 98 shows a wash drawing by Professor Tom Jones, who is famous all over the world as a medical artist. For the making of illustrations of the quality shown here a high degree of skill and knowledge is necessary Some of Professor Jones pictures look so wet and glistening in texture that one almost believes he has used Ross Board. It is a debatable point whether or not it is a compliment to say that a wash draw

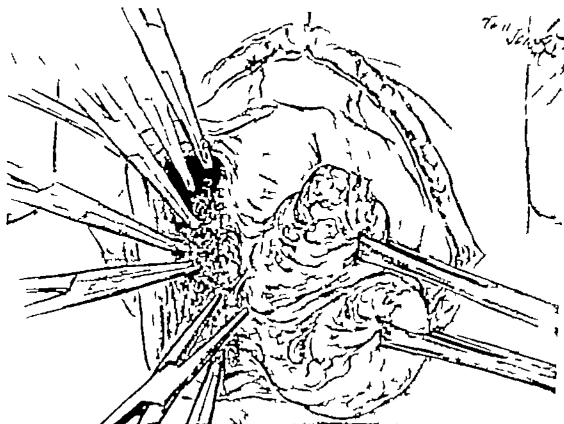


FIG. 98

Thyroidectomy one of series illustrating the operation technique. The inferior and lateral thyroid veins have been cut and the goitre rotated to reveal the trachea. Open forceps are ready to grasp the median branch of the inferior thyroid artery (By courtesy of Professor Tom Jones.)

ing is so good it might be on Ross Board. Some of the most brilliant anatomical wash drawings I know of are the illustrations in Spaltzholtz' Hand Atlas of Human Anatomy Heroux's half tone pictures sparkle and shine, and it always appears that the dissections from which he worked must have been very fresh. As far as the writer is aware, the observation and the quality of 'life about these drawings have seldom been equalled. The colouring of the various structures in these volumes demonstrates in an ideal way the combination of colour and half tone (Fig. 99). All through this anatomy the underlying form is never lost sight of when colour is used.

Wash drawings are usually made on hand made paper Hot pressed Whatman paper Fashion Board, or on any of the other water colour boards which are on the market. Hand made water-colour papers are of two kinds, Hot pressed, hard and smooth, and not pressed, which is soft and has an uneven sur face, usually described as a grain Fashion Board or Water Colour Board is available in a range of surface texture from smooth to a fairly course grain. For medical subjects

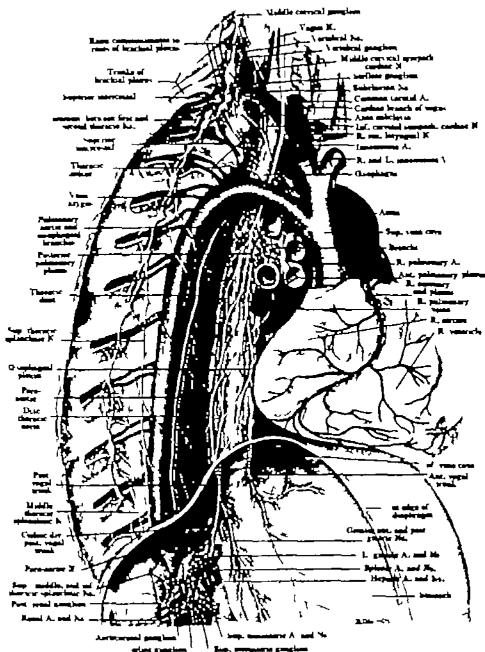


Fig. 99

It has not been possible to borrow any blocks from Spalteholz' Anatomy as these were destroyed in Germany during the war. Professor Mitchell has kindly lent this illustration from his *Basic Anatomy*. It shows dissection of the posterior pulmonary plexus made the chest on the right side. The lung has been removed. This drawing by Miss Dorothy Davison is very much in the Spalteholz tradition.

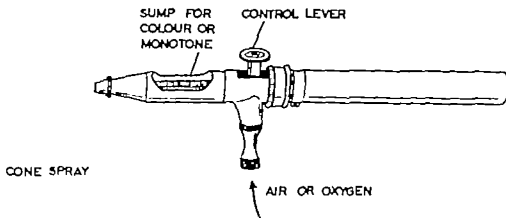


FIG. 100

There are variations and modifications of this Air-brush, but the drawing shows features common to all. The sump for instance may be covered in, or have a funnel attachment for holding extra colour

where some part or many of the surfaces to be depicted are smooth and shiny the smooth texture would be the paper or board of choice. In handling a wash drawing each artist has his own method. The most usual one is to sketch in lightly in pencil the outline and the most important landmarks in the picture. When this has been done the main tones are laid in with a large brush well charged with the water colour Stronger colour may be added while the first wash is still wet. Colour here means the monotone which is made by using ivory or lamp black diluted with water only Body colour monochrome has white added to the basic black colour How many washes are used to achieve the final effect varies from picture to picture, and with different artists. Mastery of this technique gives the most spontaneous results, and the artist may use irregularities in the drying process for the course of a blood vessel or variations in the fat or the muscles to achieve this effect.

Laying the wash is the fundamental operation in any illustration in which water is the medium, and there are several ways of laying on a flat or graded wash. One way is to damp the paper or board with a sponge before using, or soak the paper and lay it on a sheet of glass, so that it can be held at different angles while the wash runs in the required direction. Control of this medium is essential and the artist should know what is going to happen, otherwise much time will be wasted. In most wash drawings Process white is used to paint in the highlights Chinese white does not reproduce well and should never be used. As with Ross Board the brilliant highlights are the last thing to be put in any illustration.

AIR BRUSH TECHNIQUE

This is a fairly modern method of making half tone drawings. The term Air-*brush* may be misleading to anyone who has not actually seen one. The *brush* is in fact a metal cylinder about the same size as a large fountain pen (Fig. 100). It has a sump for filling with the colour or tone to be sprayed through a very fine nozzle, the density of the spray being

regulated by a lever controlled by the index finger The air is supplied through a length of tubing by a motor or from an oxygen cylinder or stored in a cylinder filled with air supplied by using a foot pump The tone or colour comes from the Air-brush in the form of a cone sprayed on to the paper and very soft effects and subtle gradations of tone can be attained. In order to control the margins of the tone, masking solutions, solvents or a paper 'mask' must be placed over the areas of the drawing which are not to be sprayed. The easiest way to make these 'masks is with tracing paper as the underlying drawing can be traced with great accuracy and even the most elaborate edge cut neatly away Density of tone is effected by the distance of the Air brush from the paper and the concentration of the spray on any one spot. Some elaboration of the details of a drawing may be made with the Air brush fine lines are drawn by holding the Air-brush almost in contact with the paper It requires practice to control the Air brush. The first movement of the controlling finger is downwards, when only air is released, and gentle pressure backwards releases the tone. As the spray starts it is advisable to keep the Air brush well away from the paper coming gradually nearer to begin work. Too much concentration on one spot will produce droplets of paint which spoil the effect. It is essential to 'build up the tone slowly and patiently to the required density spraying the same surface several times. The Air brush is particularly useful for rounded surfaces, for intestines and for other smooth and shiny objects. Most readers will have noticed the smoothness of drawings and photographs in engineering catalogues and books. But as medical drawings in half tone nearly always depict 'live tissues some people consider the Air brush technique an unsuitable medium in which to achieve this. It need not be so if the structures illustrated are drawn with knowledge and form, and not just turned into lifeless pipes.

Air brush pictures should be fixed before putting on the final highlights. It is only too easy to spoil the surface and the fixative will prevent any such disaster Pastel fixative is recommended, and once again Process white for the highlights.

Figure 101 is a typical example of A. K. Maxwell's technique. This artist experimented with various types of illustration and finally used the following method for many of his drawings. He made first a preliminary drawing correct in every detail, which was then traced on to tracing paper The back of the tracing paper was pencilled over with a 4 or 5B soft lead pencil (graphite) The tracing was then placed on top of the final paper or board and outlined with a hard 2H or 3H pencil so that when the tracing paper was lifted from the board a crisp, faint outline was visible underneath. This outline was then inked over with a thin ink line. It is at this point that Mr Maxwell's technique varies from most of the others. All the highlights, and any specially light structures such as nerves, were painted over with a solution of glue and water he also painted round the margins of the drawing with the glue-solution. The glue used was ordinary glue (gum arabic) obtainable from any stationer and mixed approximately 50/50 with water When this was dry powdered black lead was quickly worked over the whole drawing with a brush, and the general solidity was apparent almost at once. Details of dark, very dark, and black were all put in at this stage. The glue was then washed off the board with a large brush, surplus moisture being removed with blotting paper when the highlights and any other white structures stood



FIG. 10

The first stage of Paul Mikulicz colostomy The Paul tube has been tied in place. Note how the two loops of bowel are double barrelled below the abdominal wall, to facilitate subsequent closure of the colostomy with Mikulicz clamp.

(From *Surgery of Modern Warfare* by courtesy of Mr Hamilton Bailey).



FIG. 103

Manipulative treatment for the relief of paraphimosis, (constriction of the penis) it is interesting to compare this drawing with Fig. 140.

(From *Emergency Surgery* by courtesy of Mr Hamilton Bailey).

out in dazzling crispness also the drawing had a clean, crisp outline. Powdered lead or graphite is water resistant, and so the painting with glue may be repeated if necessary on any part of the drawing. *Finally the highlights were* softened with an H or 2H lead pencil also any other modelling which might be required on the white areas was drawn in with pencil. The reason for using an H or harder pencil rather than a softer lead pencil is that tone built up with a hard pencil will reproduce much better than that which might appear to be the same effect made with a soft pencil. A too soft pencil in reproduction can easily appear 'grainy' because it covers the surface of the paper much more quickly and little pits and crevices are almost inevitable.

The French artist M. Franz, used an original method for his medical drawings. They were made on yellow tracing paper with charcoal or carbon pencil, and white paint was used for the highlights. The drawings were at least life size and reproduced exceedingly well one is shown here at the suggestion and by kind permission of Mr Hamilton Bailey The reader may ask, "Why *yellow* tracing paper? The guess would be that the basic tone of the paper being comparatively dark, gives a rich effect and the highlights stand out in strong contrast. This particular drawing (Fig. 104) spent weeks under water as the result of bombing, as did so many of the other pictures made by M. Franz. How well it has stood up to this treatment is shown in the block which was made from his drawing *after* the bombing.

Mary Hawker has evolved a half-tone technique using oil paint on Scraper Board, applying the broad tones with a soft piece of rag. Structural details are put in with brushes of varying sizes, and the final result gives an *excellent representation of live tissues. Figures* 102 and 103 are typical examples of her work. In medical illustrations it is mastery of technique allied to knowledge which produces the best results. The medical artist draws what he knows as much as what he sees. Copying a medical object is not medical illustrating. The artist with a decade or more of this work behind him has only to see some of his earlier efforts, to realize how knowledge grows with the years

In the brief commentary on the drawings shown in this chapter attention has been directed more than once to the placing of the highlights. It is true to say that in medical illustrating the highlights are often *not* where they seem to be, but where experience knows they should be. This is perhaps more true of the neurosurgical pictures, but close study will

reveal that it applies to the others also Mastery in this direction comes with practice, but it is useful to bear this in mind. Form is fundamental in conveying realism, and in a medical illustration it should appear so effort less that the reader is unaware of it.

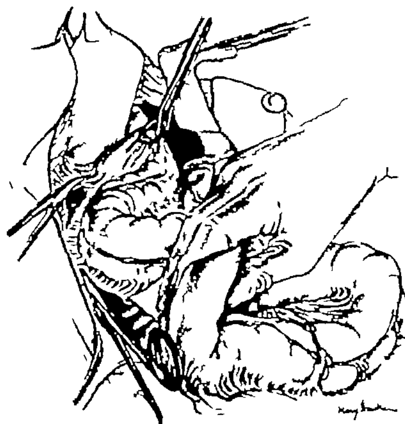


FIG. 13
Radical excision for carcinoma (cancer) of the descending or pelvic colon. Commencing mobilisation of the whole of the left side of the colon or large bowel. The scissors are cutting the peritoneum, the sac which lines the abdominal cavity



Fig. 104

The next stage in this operation. The incision of the peritoneum at the side of the rectum is continued downwards and the reflection on to the bladder is divided. These two pictures are by courtesy of Mr. Stanley Aylett.

Chapter X

The Drawing of Operations

IN the operating theatre it is much to the advantage of an artist that he can watch and draw an operation with the minimum of equipment. It seems unnecessarily obvious to say that he must be able to see clearly but occasionally even the surgeon does not realize that the person looking over his shoulder has not got the uninterrupted view that he himself has (Fig 105). Personally I have always received the utmost consideration in this respect in numerous operating theatres in large and small hospitals Anyone drawing an operation should not hesitate to ask for a stool on which to stand to get a better view An artist soon learns not to get in the way of the surgeon, his two assistants, and the theatre sister who is in charge of the instruments, which are arranged on a trolley and have to be as near to the surgeon as possible.

It should be assumed that an artist is medically trained in so far that he has a fair knowledge of anatomy and is familiar with pathological specimens, etc., before he goes into the operating theatre to *draw* Most people find that the drawings made while watching an actual operation will be much more alive than those adapted from books. If the operation should be a long one with many stages to illustrate, and suitable cases are few and far between then the surgeon will be well rewarded if he performs this operation in the post mortem room with the artist in attendance. There will be no feeling there that time is important the artist will have an uninterrupted view and it will be less embarrassing to ask questions on any point which may not be quite clear Also, there will be no audience' in the form of assistants, theatre sister and theatre staff anaesthetist and perhaps a visiting surgeon with nothing to do but watch what the artist is drawing! Figure 106 shows a series of drawings made in the post mortem room. It is a series showing the draining of the pericardium. The steps of the operation are fully illustrated. Quite a lot of information is thus summarized on one page, and the reader should be in no doubt about the anatomy or the procedure.

It is wise to make as many notes as possible in the theatre, both drawings and written observations The artist should not be tempted to rely on his memory and his anatomy books to work up the pictures of an operation seen in the theatre. He should try to have enough material on paper from which to make several detailed drawings the anatomy books should only be used for checking up on the material that has been drawn.



FIG. 95

In surgery of the chest and abdomen the area of the operation may be described as being bucket-shaped. Only the surgeon and his assistant can see the inside walls and to the bottom of the bucket. On the left is the view which the anaesthetist has and he usually sees down about one third of the wall which faces him, also anything which may be happening on the surface. In the picture on the right the camera lens was slightly behind the theatre sister. Anyone of average height who had to draw this operation (Hysterectomy the removal of the womb) would have had to stand on stool and look over the surgeon's shoulder. However, when the patient is in the lithotomy position, that used for operations on haemorrhoids etc., the surgeon would be seated, and anyone drawing needs no stool. In Figures 112 to 9 the patient was in this position.
A slightly modified lithotomy position is shown in Figure 32.

I cannot remember who said "Copying out of one book is plagiarism, but copying out of three books is research" Artists can learn much from studying the methods employed by others, and time is well spent in doing this. The standard of accuracy required by the late Sir Hugh Cairns for his neurosurgical illustrations is well shown by the fact that his artist was able to point out, when the occasion arose in the post mortem room, the exact location of a slight injury leaving no scar by the pattern of the surface of the brain which she had drawn during an operation performed many years previously

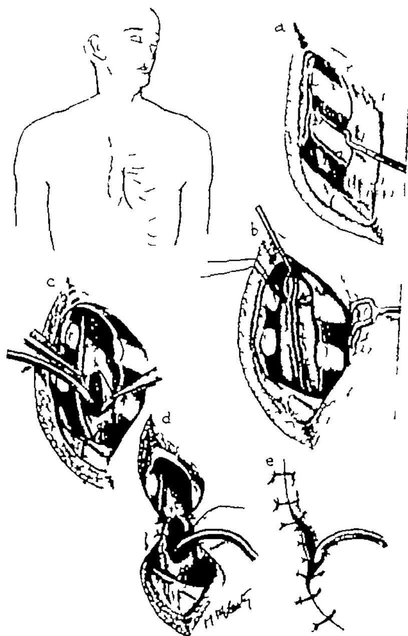


FIG. 96

Drainage of pericardium.

( ) Exposure of costal cartilage and reflection of perichondrium.
(*b*) Ligature of internal mammary vessels.
( ) Pleura reflected, pericardium incised and catheter inserted.
(*d*) Suture of edges of pericardial incision to skin.
( ) Suture of remainder of wound.

(From *Surgery of Modern Warfare* by courtesy of Mr Hamilton Bailey).

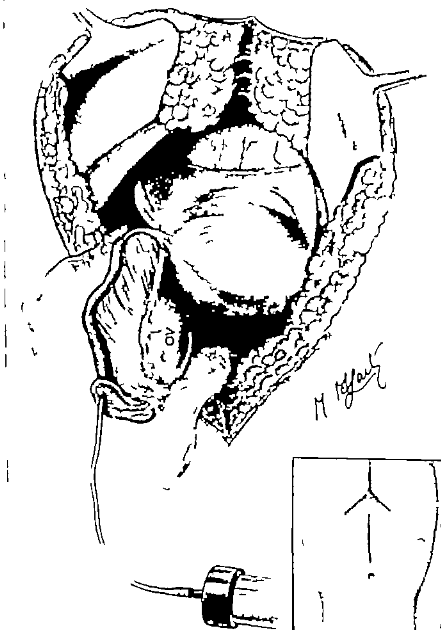


Fig 97

The first stage in the operation for cornual occlusion, blocked tubes. Ovary and tube are lying on gauze swab. The surgeon is blowing air into the tube with syringe through polythene tube which has been passed as far as the constriction. The inset shows the incision.

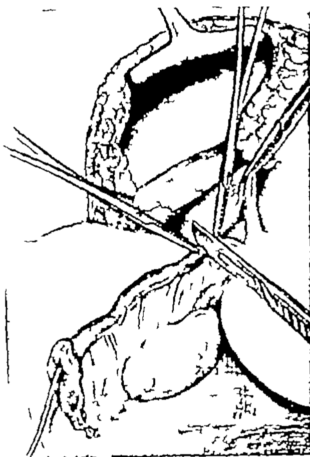


FIG. 108

FIGS. 108, 109. The tube is divided allowing the polythene to emerge. These close up pictures show one retractor and enough of the surrounding structures to make identification easy. An artery forcep is holding up the round ligament.



FIG. 109

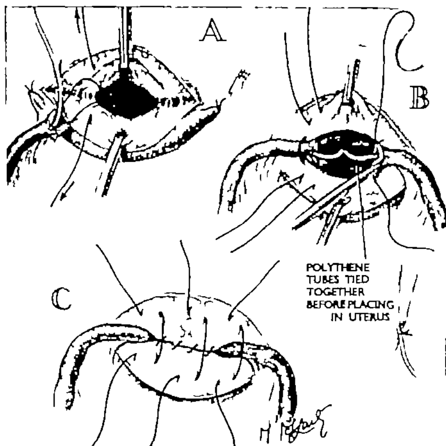


FIG. o

Both tubes are now ready to be transplanted into the body of the uterus. Details of how this is done are shown in A, B and C.

On leaving the operating theatre there should be enough material for the surgeon to say "Yes, I shall want that picture, and that, and perhaps that" It is a good plan, too, when drawing any operation, to choose something as a standard of measurement a retractor for instance, can be rapidly drawn and redrawn, whereas the edge of the wound, covered with towels and pulled in different directions from time to time, is often too variable for use as a scale. If the incision is indicated in an insert in the first drawing, the rest of the operation may well be illustrated in a series of close ups. As was said earlier the trend in medical illustrations is towards simplicity and the whole wound is seldom drawn in detail except in the first picture. Figures 106 111 show what is meant in this series illustrating cornual occlusion, a condition in which the tubes lead ing to the womb are blocked.

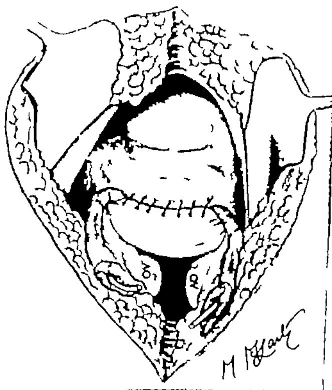


FIG. 11
The operation is complete, it only remains to stitch the various layers of the abdomen. These five figures are shown by courtesy of Mr. John Stallworthy
(From *Modern Gynaecological Practice* by Alex. Bourne).

When the author was asked to draw the operation for the plastic repair of a sphincter ani for Mr W B. Gabriel there was some doubt as to whether she would be able to get to the theatre in time to see the whole operation. The Hospital Photographer was therefore asked to take the three photographs shown in Figures 112, 113 and 114 The two theatre notebook pages are reproduced to give an idea of the extent of the drawing done in the theatre (Figs. 115 and 116). Finally the finished drawings are shown by permission of Mr Gabriel (Figs. 117 118 and 119).

When a surgeon draws as well as Mr Eric Farquharson of Edinburgh, drawing operations by post need not cause dismay Figure 120 shows this author's sketch from which Figure 121 was made. All practising medical artists should be able to produce good operative drawings from a written or verbal description, from a drawing done by the surgeon, or from reasonable photographs.



112



113



4

FIG. 12

The surgeon is about to make the first incisions. Where these incisions were is shown in Fig. 7

FIG. 3

Forceps grasp the two ends of the sphincter ani muscle which will be stitched as shown in Fig. 18 and b.

FIG. 1 4

This is the same picture as the right hand part of Fig. 119. The photographs were taken by Mr H. J R. Bussey Research Assistant at St. Marks Hospital.

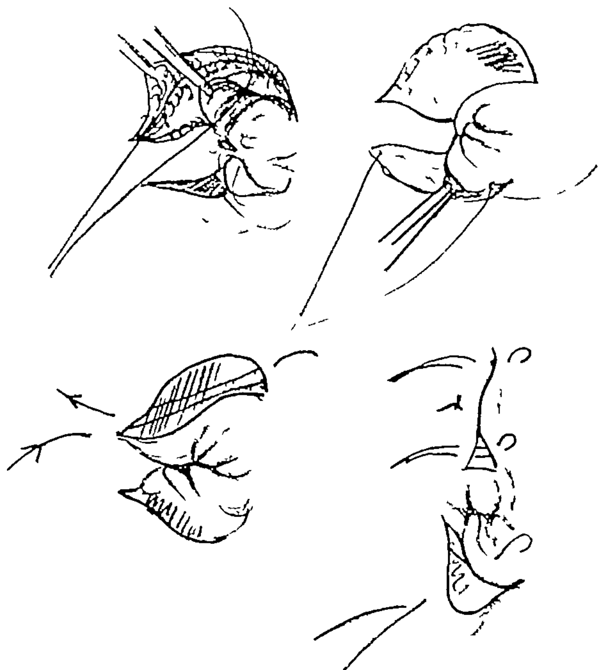


FIG. 15
Surgical sewing is sometimes so rapid that there is no time to draw in needles, arrow heads are convenient to show the route taken by the stitch.

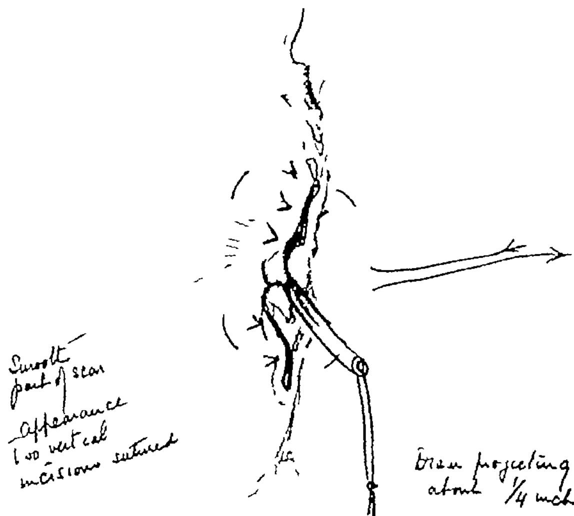
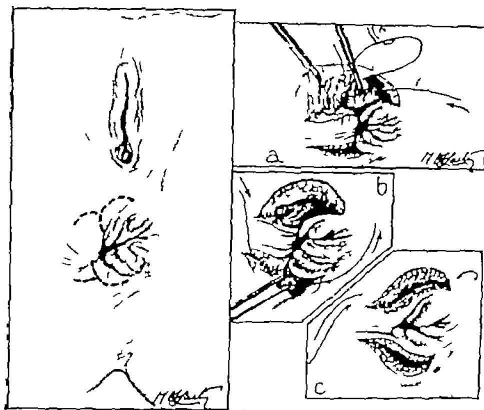


FIG. 116

Written comments are often very useful. It was decided later to omit the drain, see Figs. [illegible]4 and 1[illegible]9.

Figure 122 shows a cyst in the head of a child between the optic nerves. The main drawing incorporates all the important features of the operation. The position of the patient's head on the table with the bone flap is clearly indicated as it is the preliminary part of any cerebral operation in relation to the head. It shows, too where and how the



FIGS. 117 and 118

Blundell's operation. These drawings show the details of this procedure, the muscle bearing flaps are dissected out and sutured farther round the anal circumference. Incisions should be draw in relation to the part of the body wher the operation takes place, see also Figs. 06 and 12

dura (the skin covering the brain) was excised, and the way the brain was held back to give a view of the cyst glistening between the optic nerves The left carotid artery is visible just to the left of the optic nerve. The two ink diagrams picture the appearance of the sella (a bony structure in the middle of the head) after the removal of the cyst, and the bottom right hand drawing is a section demonstrating the anatomy of the position of the cyst in the sella and therefore in relation to the whole head.

The selective eye of an artist is unlikely to be replaced by the camera in illustrating surgery especially within the depths of a wound. Excellent colour photographs of plastic re pairs and surface surgery have often been taken, and a really beautiful series was pub lished in *Life*, February 11th, 1946. But the cost of colour reproduction makes the use of colour photography too expensive for general use in medical journals, though it is of great value in films and for use as lantern slides.

The medical artist should constantly be aware that his picture may be of value in an unexpected place. A doctor somewhere may

be performing an operation he has never done before, with perhaps the minimum of assistance and only the pictures and the written word to refer to. The author was once rather horrified when entering an operating theatre to find a series of her pictures, drawn some years before, arranged in front of the surgeon on three trolleys. There were several masked guests present, and an extra stage for this series was to be drawn. Every now and then the surgeon indicated one of these pictures, and everybody looked at the picture and then at the wound. It was a relief to know that the anatomy seemed easily recognizable, though here indeed was an unexpected test! One of the guest surgeons mentioned afterwards that he had studied these drawings most carefully before he operated on his first case of this type. From time to time one is rewarded in this way and it is an added incentive always to try to produce drawings of the highest integrity anatomically surgically and artistically

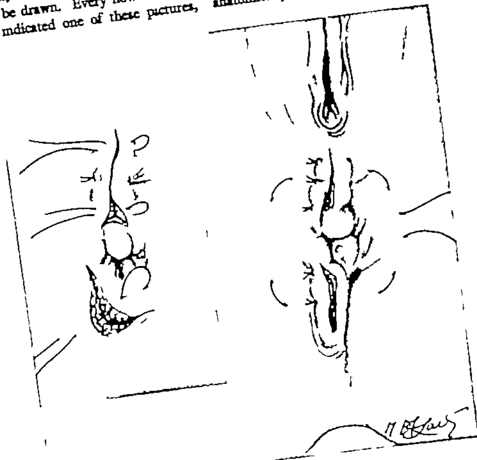


FIG. 9

These pictures show how the final stitches were placed. Originally the right hand picture was drawn to the same scale as Fig. 7 the reduction here is not so great.
(Figures 7, 8, and 9 are reproduced by permission from *Rectal Surgery* by W. B. Gabriel).

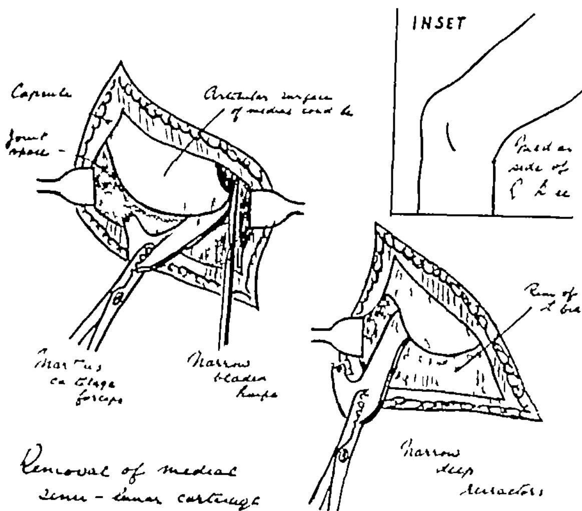


FIG. 120

Mr Farquharson drawing is detailed and exact, in fact an ideal guide from which to work.

Figure 123 illustrates an operation for pyloric stenosis, which consists of dividing and stretching part of the muscle wall just beyond the stomach of an infant. The size of the hands shows at once the tiny stomach and wound. This operation has been illustrated with the surgeon s hands out of all proportion, i.e. appearing much too small in an operation on a baby which almost looks as if the artist could not have known what he was illustrating The

operation is divided into two steps, and together they cover the whole procedure. Ross Board is the medium used. The theatre notes in this case were concentrated mostly on the proportions, and on trying to capture the texture of the stricture, and the delicate nature of the various tissues.

Figure 124 is another cerebral operation illustrating a mass of tiny vessels which are not normal on the surface of the brain. The pattern of the surface of the brain is beautifully portrayed. The bone flap, too, has its unusually well marked and abnormal pattern of gutters made by the smaller blood vessels. The exact location of the tumour in the head is pin-pointed from two positions in the two ink diagrams. The reason why the investigating needle missed the tip of the space known as the left lateral ventricle is shown in the third ink diagram. This picture links up the position of the needles in the other two diagrams. The pressure from the tumour towards and displacing the left ventricle is indicated by the arrows. One can hardly imagine more simple drawings than these three heads drawn in ink, and yet their size and placing adds interest to the drawing of the operation, and they themselves continue the delicacy of the whole.

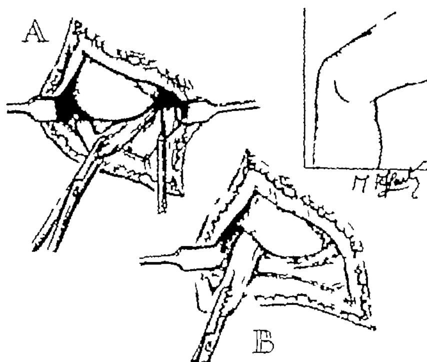


FIG. 121

The cartilage is first freed from its peripheral attachments, and at its anterior end A. It is then dislocated, if possible, into the inter-condyloid space before being detached posteriorly B.

(From *Operative Surgery* by kind permission of Mr. E. L. Farquharson

No artist should be expected to draw on his or her first visit to the operating theatre, although there is very little blood to be seen since each tiny blood vessel is tied or cauterized as it appears. The newcomer should at first be able to look round and see the co-ordinated work of all the people in the theatre without having to keep his eyes glued to the wound.





FIG. 122

When a bone flap is cut from the skull, the saw cuts between the burr holes are made at an angle from within outwards, so that when the bone-flap is replaced it cannot fall or be pushed onto the brain. (Drawn for the late Sir Hugh Cairns).

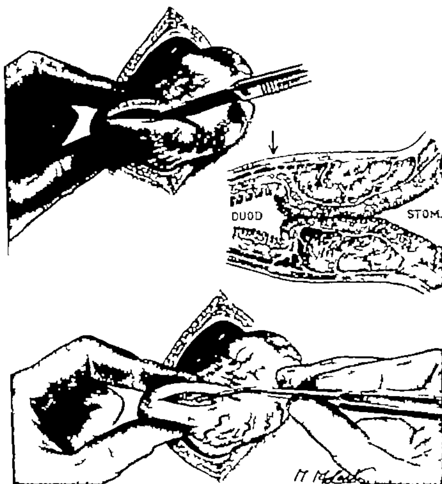


Fig. 23

Rammstedt's operation for congenital pyloric stenosis. The incision should divide all except the deepest of the circular muscle fibres. The remaining fibres are gently teased apart with blunt dissector. The arrow indicates where special care must be taken to avoid penetration of the wall beyond the constriction.
(From *Operative Surgery* by kind permission of Mr. E. L. Farquharson).

In this way the atmosphere of the theatre, which is not dramatic, unless the staff is dealing with an emergency becomes familiar Everything is quietly efficient surgeon and theatre sister talk to one another in normally pitched voices. For them this is routine certainly no time is wasted, and they quickly get on with the job with only a few words. The anaesthetist nods reassuringly when the surgeon catches his eye. The surgeon may be teaching students either in the gallery or standing behind him on the floor This means a series of comments if not a running commentary on what he is doing, and makes the

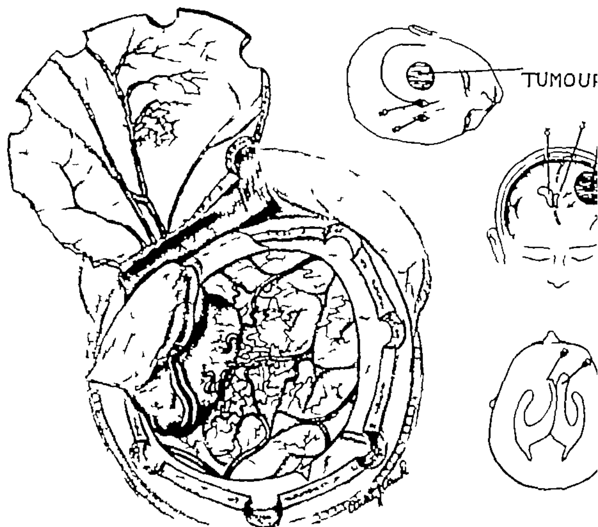


FIG. 24

A circumscribed tumour is being detached from the brain. A very large blood vessel runs along the side and there is an intricate pattern of small vessels on the surface of the brain. Ink diagrams combine well with half tone when extra information is needed. The top diagram shows the incision of the scalp.

(Drawn for the Department of Neurological Surgery Radcliffe Infirmary Oxford).

operation more *interesting for the theatre staff* and for any onlookers Even a nurse or a medical student may faint on their first visit to the theatre, which is nothing to be ashamed of and it is very unlikely to happen twice. *Familiarity with the routine brings confidence*, and the artist soon realizes that the smooth efficiency which surrounds the patient is the result of a team of experts working together and he then becomes a member of this team.

Chapter XI

Photographic Aids and Mechanical Aids

SOME readers may have had little practice in the use of any camera that is not just the snapshot camera, and they may be unaware of some of the occasions when a camera, used, perhaps, in an unorthodox way can save time and aid draughtsmanship.

One problem which faces the medical photographer (though it is not such a problem for the artist) is that of providing illumination in the depths of a cavity Figures 125 and 126 demonstrate this point in a case which is admittedly ideally suitable for drawing. The

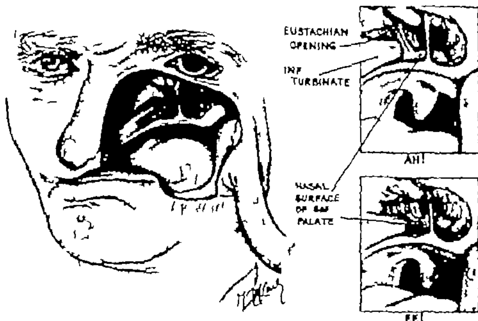


FIG. 125

Artist' drawing of nasopharynx seen from above.

(Compare with photographs in Fig. 126).

AH Note height of elevation of the soft palate as seen from the nasal surface and corresponding depression or dimple on the cheek side.

EE Elevation of the soft palate is more marked, the nasal mound of mucous and muscle seen on the nasal aspect of the soft palate is larger but the dimple on the cheek side is about the same size as in AH. Note the marked narrowing of the nasopharynx due to contraction of the lateral pharyngeal muscles.



FIG. 126

A and B, The patient when referred for reconstruction of the face.

C, The palate at rest, uvula hanging vertically downwards.

D saying AH' Note dimple on the surface of the soft palate, corresponding to the nasal mound which cannot be seen in this view

(These two figures are by courtesy of Mr J Calnan.)

movements of what remains of the soft palate inside the head were not at all easy to see, but good glimpses were sufficient, and the patient was most co-operative. If the artist can see what he is asked to draw he should be able to produce a picture.



Fig. 127
'Lantern jaw' acromegaly showing the typical heavy features of this disease.



Fig. 128
The spade-like hands confirm the diagnosis of acromegaly

(From *Physical Signs in Clinical Surgery* by courtesy of Mr Hamilton Bailey).

Most authorities are agreed, however that there are many subjects which should be illustrated by photographs, and Mr Hamilton Bailey's *Physical Signs in Clinical Surgery* is a textbook which emphasizes this very clearly typical examples of these illustrations being the two pictures shown in Figures 127 and 128 The camera can present physical signs in a way which is most realistic and convincing to the reader and a few photographs are included to show the type of picture that is meant. *Figures 129 130 and 131 demonstrate* strikingly the eye signs of the stages of anaesthesia when nitrous oxide is being administered to a patient sitting in a dental chair This is an excellent series of pictures for teaching. They could be turned into line or half tone drawings but the fact that they *are* photographs is of great value. In this case it is the life-like quality of the photograph which is the real teaching aid In Figure 132 also the little patient is being encouraged to find out if ethyl chloride, which for children has Eau de Cologne added, smells like Mummy's scent. This is another obvious subject for photography

The patient with the Horner's Syndrome was photographed in the Casualty Department (Fig. 133). No special lighting was available, so this patient was wheeled outside on the trolley for a moment while a daylight exposure was made. In this particular case the artist *was asked to "come and draw a patient in* Casualty" The camera happened to be loaded and ready so it was taken along. To draw this patient carefully would have delayed the medical treatment, though notes could have been made at the time, and a drawing completed later

A syndrome is set of two, three or more symptoms occurring concurrently In the Horner's syndrome they are the small pupil, sinking in of the eyeball, and drooping of the upper lid on the affected side.



FIG. 1 9



FIG. 130



FIG. 13



FIG. 32

FIG. 129.—Early on in the administration of the nitrous oxide the eyelid is resistant, should it be drawn back by the anaesthetist.

FIG. 130.—If the eye appears to be able to focus, unconsciousness has not been reached.

FIG. 3 —In healthy individuals anaesthesia deep enough for dental extraction is attained before the eyes become fixed out of centre the anaesthetic should continue until this fixation is reached.

FIG. 132.—The child is persuaded to hold the mask about *ten inches away from her face, while ethyl chloride is* sprayed on it. *The anaesthetist talks continuously and* by various manoeuvres the mask is gradually lowered on to the face. The Great Ormond Street method, which has much to commend it.

(From *Essentials of General Anaesthesia* by kind permission of Sir Robert Macintosh and Dr Freda B. Pratt Bannister).



FIG. 33
This photograph shows ( ) the small pupil; ( ) the sinking in of the eyeball, and (3) the drooping upper lid of patient with Horner's syndrome. Other signs are that the skin is dry and flushed on the affected side (patient's left).
(From *Local Analgesia, Brachial Plexus* by courtesy of Sir Robert Macintosh and Dr William W Mushin).

PHOTO MONTAGE

This title includes every illustration in which photographs or parts of a photograph are combined with a drawing to make a picture. An artist who can use a camera has a useful asset to his talents, and photographic knowledge and accomplishments are constantly useful. The surgeon's hands in Figures 134 and 135 were enlarged from a various assortment of negatives. The parts of the picture which were drawn by hand were done on Ross Board, and

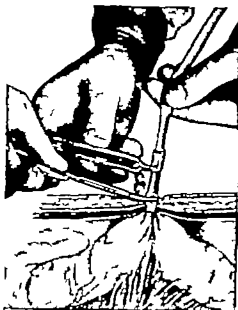


FIG. 34A

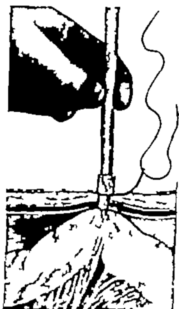


FIG. 34B

Fig. 134 A and B. The insertion of a prepared ileostomy tube, two holes near the tip are shown by the dotted line. The cuff on the tube marks the extent to which the tube should be inserted. When that point is reached it is stitched to the abdominal wall B.
(Ileostomy the surgical formation of passage through the abdominal wall into the lower half of the small bowel.)



FIG. 35

any edges of paper or board which might have cast shadows were faded off with the Air brush. It was found that Ilford Plastika Bromide Paper B.2K or B.3K was the best photo graphic surface to use for these photo montage pictures. The surface of the paper like Ross Board is creamy' white rather than snow' white and, since it has a matt surface, a con siderable amount of drawing can be done on it.

In the two pictures showing the anatomy of the brachial plexus (Figs 136 and 137), the part of the print on which the drawing was *going to be made was faded out as the prints* were enlarged. Several types of print were tried, but finally the result was as shown here.

Fig. 135.—*Strangulated inguinal hernia*, dividing light constriction in the neck of the sac. The director protects the imprisoned gut. (The inguinal region is in the groin.)
(Figs. 134 and 35 from *Emergency Surgery* by kind per mission of Mr Hamilton Bailey).

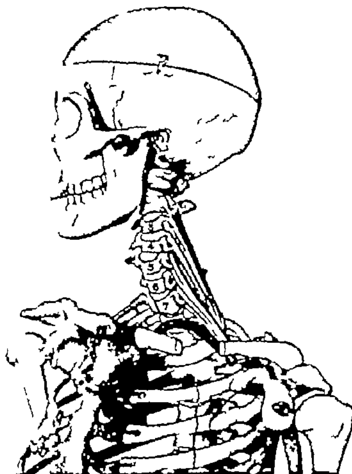


FIG. 36
The first stage in building up th anatomy of the brachial plexus on photograph of a skeleton. Part of the clavicle has been removed to show these structures crossing the first rib.
(From *Local Analgesia Brachial Plexus* by courtesy of Sir Robert Macintosh and Dr. William W. Mushin).

The use of colour is most effective in differentiating the structures. If colour had not been available, a close-up type of drawing would have been necessary. The position of the skeleton in these pictures coincides exactly with the position of the patient when a local anaesthetic, in the form of a brachial plexus block of the nerves leading to the arm is being administered. Previous drawings in the book make this clear but as these pictures are taken



FIG. 37
The next step which adds another muscle (*scalenus anticus*) two branches from the artery and the sub-clavian vein. The final picture in this series shows the skeleton inside body The anaesthetist' hands are shown, too. He is directing the needle towards its target.
(From *Local Analgesia, Brachial Plexus* by courtesy of Sir Robert Macintosh and Dr William W Mushin).

out of their setting it seems as well to explain why so much of the skeleton is shown. Just as the speed of the convoy is that of the slowest vessel it is a good idea to remember to write and to illustrate for those who may be rather slow in assimilating information. This entails more thought and care for the author and the artist as it is very much easier to draw in all the anatomy' than to simplify a picture down to the essentials.

A METHOD OF OUTLINING DRAWINGS ON THE FOCUSING SCREEN OF A CAMERA

A friend of mine who is a surgeon and is keen on illustrations has a neat way of making drawings of hands and instruments when they have to be viewed from an unusual angle. An assistant poses his hands in the positions required, the surgeon then focuses his ½ plate camera on the field, and draws the hands with pencil or ink in outline on the ground glass focusing screen. This is an easily set up method of obtaining outline pictures and one that could be used more often. Should a whole plate camera be available, the procedure is simpler because the ground glass is larger and considerably more detail may be put in. Gross specimens which are not suitable for photography may be drawn to a very reduced scale in this way. To make an accurate drawing of a patient in an unusual position on an operating table or in a complicated fracture frame is easier and quicker for the inexperienced artist on the ground glass of a camera than by free hand sketching (Fig. 138). With this method some practice is, of course, desirable, but anyone doing this for the first time is usually sufficiently satisfied with the result to try again. The selection of which lines to trace and which to leave out is also a matter of experience. Too many lines are as difficult to interpret as too few. To give an example, when drawing a blood vessel or a nerve, instead of drawing two thin lines it is best always to draw the right hand line and to draw it firmly. The reason for this is that most people are right handed and sit naturally with the source of light coming from the left.

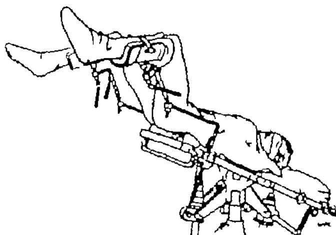


Fig. 138

This picture was drawn by an expert but it could have been made on the ground glass of camera by an inexperienced artist. In the ordinary Lithotomy position the body part of the operating table is parallel to the floor. This shows the combined Lithotomy—Trendelenburg position.

(From *Operative Surgery* by courtesy of Mr. B. L. Farquharson).

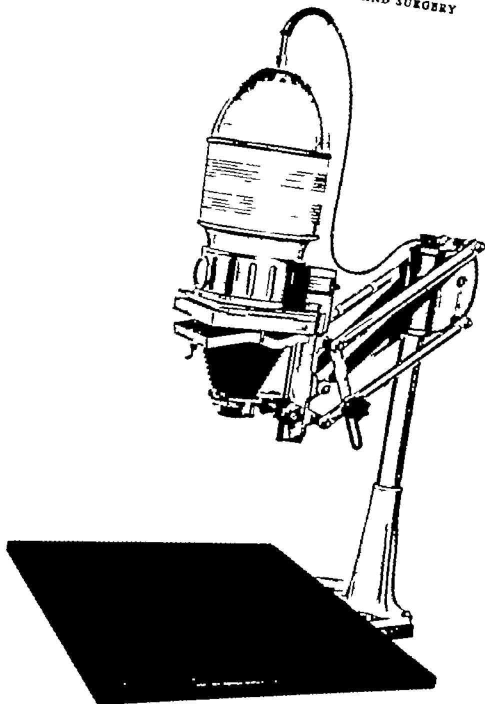


FIG. 139

The Johnson V 4-5 Enlarger typical modern enlarger it will take plates or film up to 4 × 5 inches. (*By courtesy of Johnson of Hendon Ltd.*).

PRODUCING DRAWINGS FROM PHOTOGRAPHIC NEGATIVES AND COLOUR TRANSPARENCIES

Anyone who has access to an enlarger would nd it useful for turning photographs into line rawings. Most enlargers nowadays project he image downwards on to the table or bench n which they stand. Figure 139 shows a ypical modern enlarger. Consequently it is asier to outline drawings on a table rather han against a wall or upright surface. It vould not be the method of choice to trace ound an image projected by an enlarger if a rint were available, as this has to be done in he semi-dark but for quick and accurate nlargement it is very helpful.

Many research workers outline photographs n ink in order to turn them into line drawings or diagrams for publication. This is done with a pen and waterproof indian ink. All details to be shown must be inked in on the print, and when this is completed the photographic image can be faded off the print with a solution Potassium bichromate, 50 g. water 500 cc.

Leave the print in the solution until all the blackest parts have taken on the colour of the solution. Make certain of this before rinsing the print and putting it in an ordinary hypo bath. The print should be handled very carefully the ink lines must not be touched while they are wet or they might smudge. When the print is clear of all the grey tones and only the ink remains, remove it from the hypo bath, wash it as for an ordinary photographic print, and dry. Alternative solution

Copper sulphate crystals	(2 oz.) 5 gr	(100 g.)
Sodium chloride	(2 oz.) 5 gr	(100 g.)
Sulphuric or hydrochloric acid	(½ oz.)	(25 cc.)
Water	(20 oz.)	(1,000 cc.)

Bleach the print in the above solution until



FIG. 140

Paraphimosis, a condition where there is a constriction band around the shaft of the penis. This can sometimes be reduced by manual manipulation.

(From *Operative Surgery* by courtesy of Mr. E. L. Farquharson).

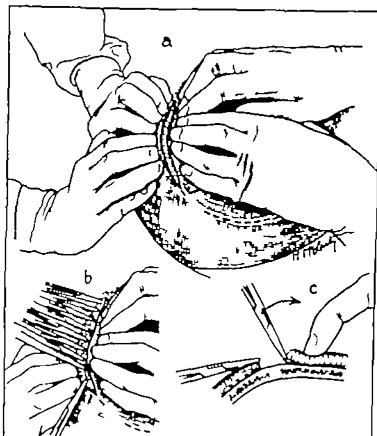


FIG. 141

Technique of incision and haemostasis of scalp. ( ) Incision of scalp with edges compressed against skull by finger-tips; (b) and ( ) Mode of application of fine artery forceps to edge of aponeurosis and eversion of this by weight of forceps to occlude all severed scalp vessels. The procedure will be repeated as required, as indicated by dotted line in ( ). (The aponeurosis is the fibrous membrane lying under the fat of the scalp and on top of the skull). (From *Surgery of Modern Warfare* by courtesy of Mr Hamilton Bailey).

only a faint image remains. This will take about 6 7 minutes. Then remove the silver chloride residue in 20° to 30° plain hypo crystals diluted in water After fixing there should be no trace of the original image only the ink lines remain. Prints which are not suitable for reproduction (either because they are not sharp enough, or because the journal for which they are intended does not accept illustrations which require a half tone block) often prove valuable as illustrations when treated in this way

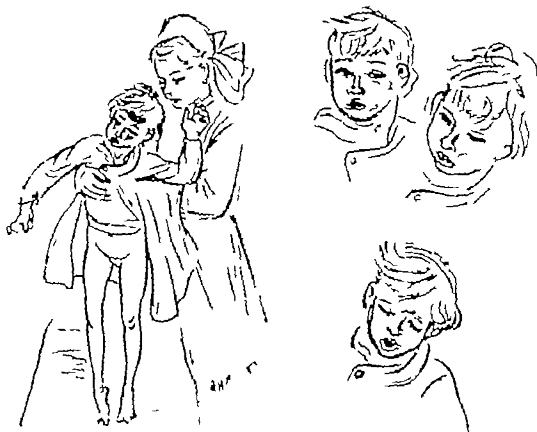


Fig. 142.

Nothing is so difficult to record as continuous movement. This picture manages to convey the jerky shaking type of movement from which this little girl was suffering.

(Drawn for the Department of Paediatrics, Radcliffe Infirmary Oxford).

THE DYNAMICS OF MOTION

Every artist will agree that this is hard to capture. Included here at the suggestion of Mr Eric Farquharson is an illustration of paraphimosis which demonstrates motion exceedingly well. Mr Farquharson made the plasticine model himself and his hands were photographed in exactly the position required (Fig. 140). To make a first class illustration all the artist had to do was a little shading on the matt print. Figure 141 is an ink line drawing not actually traced but drawn from photographs. As part c of this drawing could not be shown photographically it was decided that a and 'b' should be drawn to save space and make one block. Figure 142 shows a drawing of a little patient who could not be photographed because she was never still even when asleep.

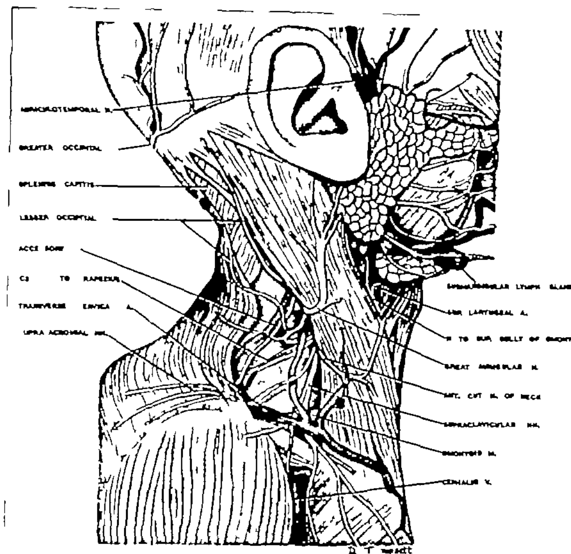


Fig. 43

A superficial dissection of the right side of the neck and face. The prevertebral fascia is intact in the lower part of the posterior triangle. A drawing by Dr Tompsett of Specimen S.390 in the Museum of the Royal College of Surgeons. (*By courtesy of Professor Last*).

DRAWING ON MATT PRINTS

Some research workers make drawings on top of a very lightly printed photograph, and the result is usually excellent. Another method sometimes used to illustrate gross dissections is to photograph the specimen and make a print enlarged up to life size. This is th[…] traced and used as the basis of a detailed an[…]tomical drawing. Dr Tompsett, Prosector […]the Royal College of Surgeons uses th[…] method with great success (Fig. 143). Th[…]



FIG. 144
The photograph from which Fig. 45 was drawn. Several positions of the electrode and pad in relation to limbs had to be shown and photographs were quicker method than sketching.

drawings in cross section anatomy books have usually been produced in this way as this ensures that the basic proportions are correct, and details may be emphasized or exaggerated if and where necessary Artefacts may be corrected in the drawing, and yet the final picture is clear easily understood, and has much more sense of form than would be possible with a photograph however good.

No one engaged in producing scientific illustrations should scorn to trace from photographs if they will assist the final result, save time, and make the work less tedious. The best way to trace from photographs is on cellophane or cellulose acetate with indian ink. Cellulose acetate 001 will not shrink, stretch, or wrinkle when ink is painted on to it. Handle this as little as possible, as any grease will make the

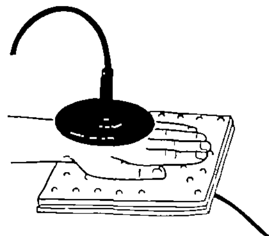


FIG. 45
One of series of drawings from *The Principles and Practice of Diathermy* by courtesy of Dr B. O Scott.

surface difficult to work on. It can be cleaned with methylated spirit. Tracing paper or tracing linen even the best quality is hardly transparent enough, and the results may be discouraging.

Finally drawings adapted from photographs make good illustrations. One way of doing this is shown in Figures 144 and 145 where the photograph has been adapted and not just copied.

MECHANICAL AIDS

It may be assumed in general that a trained artist can draw anything put before him, to any scale and in perspective. The following mechanical aids, however save time and are worth recording Even if the advice given is already well known to some readers, it may nevertheless be helpful to research workers and to students whose main interest is not necessarily visual. Sometimes the answer to a question seems obvious, but is not so, after we have heard the answer

DRAWING SPECIMENS

If a specimen is flat, such as a section of brain, liver or lung, place a piece of thin glass over it and in direct contact with it, and then trace in on this piece of glass with a pen or fine brush and indian ink the outline of the object and all other details which are required. This is an excellent method of getting the correct proportions in the shortest possible time (Figs 146 and 147). It is important that the head should be held in the same position while doing the tracing, and the artist should not try to see round corners, otherwise the drawing will not be absolutely true. If the specimen is not just flat, then the glass placed over it must be supported just above the object to be drawn. A photographic developing dish is ideal for this purpose as the glass will then rest on the edges of the dish, and it will be steady and easy to work on (Fig. 148). On occasion it may be necessary to raise the glass above the edges of the dish, on books, for instance, in order to have a more comprehensive view of the whole object. It is an added aid to accuracy to employ a 'peephole at eye level above the glass This is done by making a small circular hole (¼ inch diam. is suggested) in a piece of black cardboard. The peephole may be adjusted to eye level by holding it in a retort stand (Fig. 149) The object of the peephole is to make it impossible for the artist to move his line of vision more than a fraction, to try to see round corners and so to distort the picture. The more detail required, the more useful the peephole will be. The actual execution of the drawing may *take a little* longer but the result will be correct.

It is not always necessary to look *down* on a specimen, a sheet of glass may be held in a stand at right angles to the table and between the artist and the object to be drawn. By this method the nearer the glass is to the object, the larger the drawing will be the drawing therefore cannot ever be larger than life size (Fig. 149) Here again a peephole is an aid to

Fig. 146.—The outline and proportions and the principle land marks of the specimen shown below. If the artist had had to finish this drawing *without* the specimen as sometimes happens, more drawing would have been necessary on the glass.

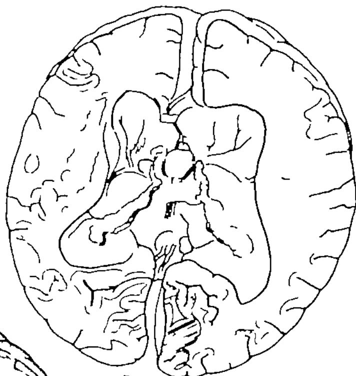


Fig. 146

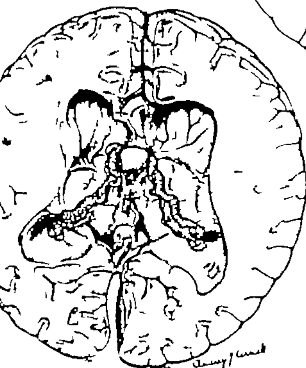


Fig. 147

Fig. 147. This shows coronal section through the brain, the eye is looking t this specimen from bove downwards.
(Drawn for the late Sir Hugh Cairns).

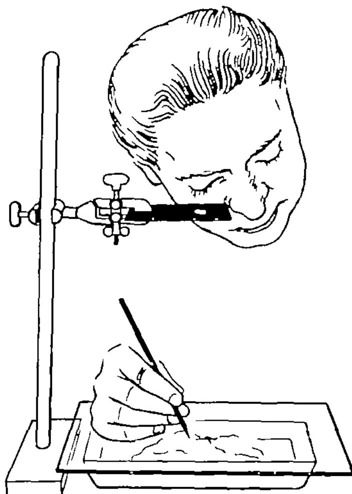


FIG. 148

Tracing on glass the outline and details of specimen which is lying in a photographic dish, such as the brain section shown in the preceding figures. The peephole is in use.

draughtsmanship It is always best, if possible, to draw any specimen to natural size, as points of measurement can then be checked more easily When using glass the surface should first be cleaned with methylated spirit to remove any grease. It is possible to draw on glass with a ball point pen quite as successfully as with indian ink provided the glass is free from grease.

A drawing made on glass may be photographed as it is, by placing white paper behind the glass, and lighting the drawing either from behind, as in an X ray or by direct frontal lighting. Alternatively the glass may be placed under tracing paper on which the picture can be redrawn carefully and more tidily for use as it is, or for transferring on to Scraper Board or Ross Board. If the drawing is intended for Ross Board, as in Figure 147 the tracing paper stage should be made with a 3B carbon pencil and not with a lead pencil, in order to make a suitable transfer

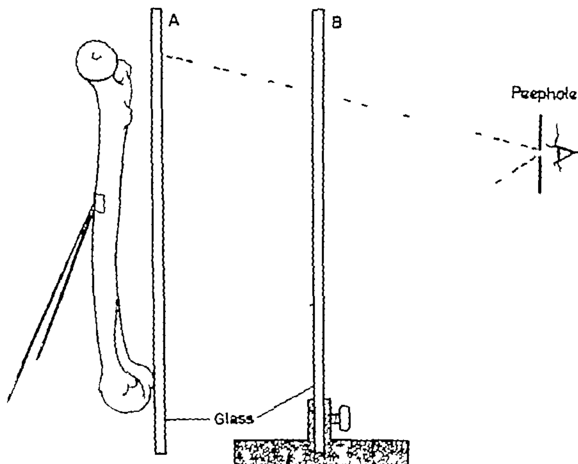


FIG. 149
A method of arranging the glass and the peep-hole when drawing an object such as long bone. If the outline is drawn on glass A it will be life-size, if drawn on B the picture will be considerably smaller

PRODUCING QUICK DRAWINGS FOR LANTERN SLIDES

Cellulose acetate or cellophane, as it is more commonly called, takes indian ink excellently very fine lines can be drawn on it, and it can be laid over glass for the redrawing of a picture. Should the picture be small enough, that is not larger than 3 inches by 3 inches, the cellophane can be trimmed and bound between two cover glasses to make a quick lantern slide. The size of the standard glass lantern slide is $3\frac{1}{4} \times 3\frac{1}{4}$ but sufficient margin should be left for binding the slide, as some lantern slide carriers cut out more of the picture area than others

Drawings made directly on to cellophane or glass for projection are often very effective, but to do this well, practice is required, since all irregularities of line and letter will be magnified on the screen in rather an alarming way. Typescript on tracing paper, Kodatrace or Astrafoil, provided that the typewriter ribbon is new, is also quite successful for tables and statistics for use as last minute lantern slides. If typescript should have to be photographed, the best way to get really black letters is to place the carbon paper under the typing paper with the carbon side facing the typist.

The typescript of an electric typewriter is ideal for photography as the letters are of an even density of tone and are altogether cleaner and crisper to look at than those made by an ordinary typewriter (Fig. 150). In fact the labelling of drawings can be done entirely with an electric typewriter because if the typescript is too small as it is, it may be enlarged photographically to the size required, and the labels may then be 'patched in' around or on the drawing.

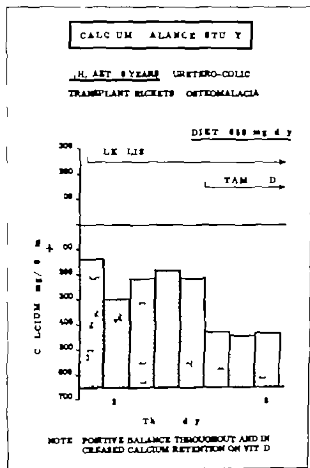


Fig. 150A.
This chart was made with an electric typewriter. It may well be that in the future the electric typewriter will supplant lettering guides in the making of charts. (By courtesy of Miss Freda Wadsworth.)

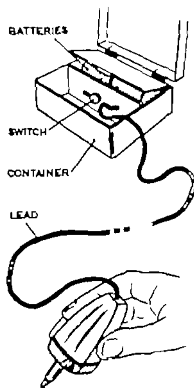


Fig. 150B.
A valuable piece of equipment not mentioned in the text is an electric eraser. This is battery operated and may be obtained from Harrods Ltd., Knightsbridge, London, S.W.1

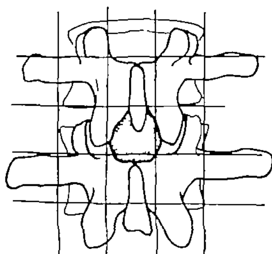


FIG. 151

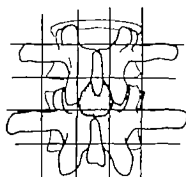


FIG. 152

FIG. 151.—The lines of the grid are left open to show that grid may be of any size.

FIG. 152.—This figure is reduced by 25% that is three-quarters the size of Fig. 151.

(Figs 151 and 152 from *Lumbar Puncture and Spinal Analgesia* by courtesy of Sir Robert Macintosh).

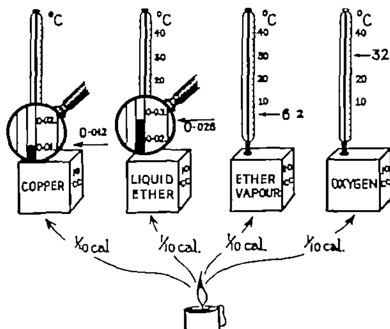


FIG. 153

A method of drawing attention to two points in a schematic diagram. Magnification of the scale makes the slight variation in temperature easily readable.

(Part of a drawing for *Physics for the Anaesthetist* made under the direction of Dr Epstein. By courtesy of Sir Robert Macintosh and Dr William W Mushin).

ENLARGING OR REDUCING A DRAWING

To enlarge a drawing other than photographically requires mechanical aid for accuracy and speed. A simple method is to rule out on thin cellulose acetate or cellophane a grid say 8 × 6 or larger divided into inch squares. On another sheet of similar size rule out a grid of about the same size divided into half inch squares. Then, if the drawing has to be enlarged twice the size, put the ½ inch grid over the drawing and the inch grid under your tracing paper and mark off all the points at which the lines of the drawing cross the lines of the grid (Figs. 151 and 152). By reversing the grids (the inch grid on the drawing and the ½ inch under the paper) a drawing half the size will be made. Any grids ruled should be stored carefully and kept flat so they may be used on future occasions Details of importance can be pin pointed by drawing a magnifying glass around any point to be emphasized (Fig 153).

To turn a small picture from a book into a 'wall drawing' that is, a drawing large enough to hang on a wall for teaching, the quickest method is to use an epidiascope and project the picture on to paper pinned to a wall. If no epidiascope is available, the enlargement must be made by the grid method or by a pantograph (Fig. 154). If a grid is used a small one is placed over the drawing in the book, but the other grid should be faintly ruled on to the paper as the squares might be as big as 5 or 6 and a faint pencil grid can always be rubbed out afterwards. It is worth recording here that most standard epidiascopes will not accommodate a picture larger than 6 × 6 so the artist should bear this in mind when drawing specifically for projection by this method. Nothing looks so bad on the screen as an amputated drawing.

THE PANTOGRAPH

The Pantograph is an instrument used for enlarging a drawing, plan or map etc. (Fig. 154). It is essential to use the Pantograph on an entirely flat surface, with the subject to be copied to the *left* of the copying paper Both pieces of paper must be fastened by drawing pins or scotch tape. The pivot (A) must be securely fixed to the board or table, and the two metal screws (A) and (B) must be placed through the number on each arm which indicates the size of the enlargement required. The screw pivot at the end of arm (a), the metal tracer (B) and the pencil (C) should be in the positions shown in Figure 154. The operator follows the outline of the subject to be enlarged with the tracer point beginning at a point as near to the centre of the subject as possible. Slight pressure should be put on the pencil (C) but as this is not very easy a solid brass weight was made (D) with a hole through it so that it could be dropped over the pencil to keep it in contact with the paper The Pantograph illustrated is a drawing of a wooden model which costs about 15/ and which will enlarge up to 8 times the original size. Pantographs made of metal are also on the market, but they cost considerably more than the one in Figure 154 which is of the simplest type. However as this one works well and illustrates the principle, it is shown in preference to one of more elaborate design.

THE CAMERA LUCIDA

This is an instrument which was designed for the old type of monocular microscope. The camera lucida is fixed above the eyepiece of the microscope, and by a prism of mirrors reflects the image seen down the microscope on to a piece of paper laid on the table beside the microscope. This instrument may also be

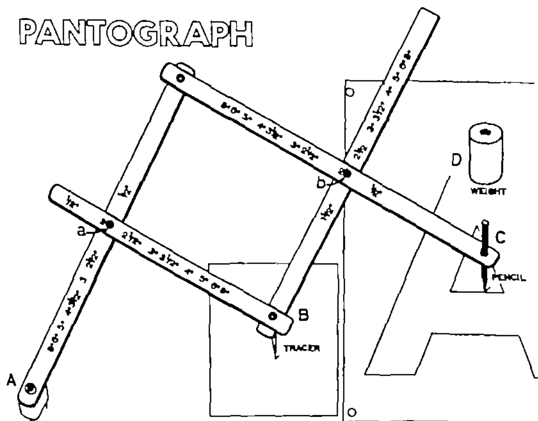


FIG. 54
The Pantograph. The operator guides the tracer (B) round the letter A. The metal screws are placed at 'a' on the tracer arm at point and the pencil arm at point b; and the enlargement drawn by the pencil (C) is then twice that of the original letter.

used for drawing specimens, or in fact any object which is not too large. It is merely a question of fixing the camera lucida in such a way that the object seen through the eyepiece is reflected on to the paper lying alongside it. The outline and any other details may then be drawn in with great accuracy

Figure 155 shows a simple method of enlarging or reducing a rectangle. This is particularly useful for determining how large or how small a drawing should be to fill a page or column of a given size. It was mentioned in Chapter VIII that drawings prepared for uniform reduction (2 3 of the original size, being the figure given) make for economy in the cost of making blocks.

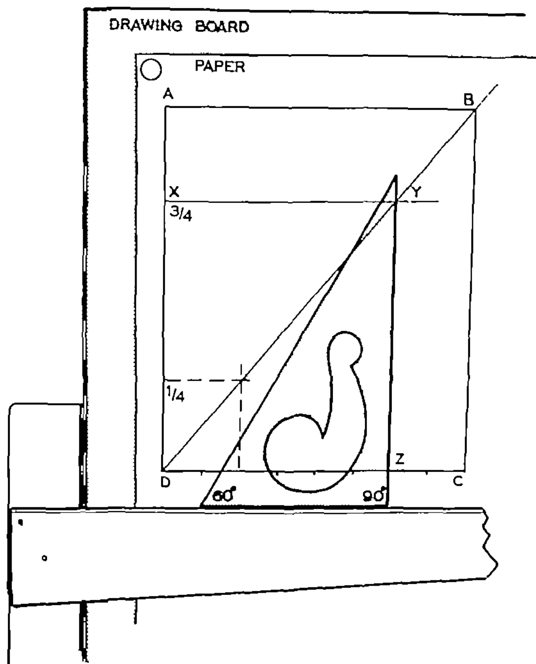


Fig. 155

T enlarge or reduce a rectangle
Join points B and D
2. Measure off on DC the size of the required reduction.
3. At this measurement point Z draw line at right angles till it meets the line BD
4. At this point Y draw XY parallel to AB.
The rectangle XYZD is three quarters the size of ABCD

Colour

AMONG artists there will always be a certain amount of controversy about colour as no two people looking at the same object are likely to see colour in the same way Walk round a life class or still life class in an Art School and the truth of this is apparent.

A number of people interested in illustrating medicine say quite dogmatically that the coloured photograph has superseded the artist in the recording of specimens. That this may be so in 90% of specimen records, is probably true, but there will always be specimens that should be painted by an artist. The experienced medical artist can give a specimen 'something' which will make the reason for the picture more convincing to the onlooker He will be able to arrange the subject to its best advantage, possibly propped up in a way that might be unsuitable for photography The artist can repair an artefact and add, if necessary some surrounding structure which will make identification easier or even obvious.

It is desirable, too, that the specimen should be seen at the best possible moment, and especially is this so if the colour is an important clinical factor The best moment is immediately on removal or even *in situ*. A painting of a specimen in a tank can look like a fresh one, even if not seen immediately on resection, but if it is viewed at once the picture will probably be a much better one. However carefully a specimen is handled and preserved it is indeed very different in appearance from what it was at the time of its removal (Figs. 156 and 157).

When making gastroscopic and laparoscopic





Fig 156 Fig 157

Fig 156 Apical tumour of the bladder its appearance immediately following operation

Fig 157 The same specimen painted eight days later

pictures the colour has to be memorized. At the time a few pencil notes are taken, from which the final picture will be made later. Laparoscopy or peritoneoscopy as it is called in America, is a procedure to visualise the abdominal cavity and its contents with an optical instrument. The instrument is inserted through a very small puncture and causes no discomfort to the patient.

In endoscopic illustrations colour is nearly always used, although it is true that different gastroscopes and ophthalmoscopes give different illumination a painting in colour seems to be the ideal technique in this field. Dorothy Barber of the Central *Middlesex Hospital is an* acknowledged expert in the recording of endoscopic views. She points out the subtle difference in illumination when the field is distended with fluid, as in cystoscopic pictures and with air as in gastroscopy and sigmoidoscopy work. In these latter views the highlights are well defined throughout, whereas with the cystoscope the light is diffused, becoming more so towards the periphery of the picture (Figs. 158 and 159).

To use any of the 'scopes' really well requires practice and patience, and these are essential for recording with the ophthalmoscope. Ophthalmology was one of the first specialities to detach itself from general medicine. The slit lamp was introduced in 1911 and this complex instrument gives a focused illumination of the anterior 'chamber' of the eye. Used with the corneal microscope the slit lamp enables a magnified examination of the conjunctiva, cornea, iris, and lens to be made. Some artists specialising in ophthalmology have made beautiful slit lamp illustrations and, for those who do not know it may be of interest that to manipulate the slit lamp requires *both* hands. It has already been said that no one artist can be an expert in all branches of medical illustration, and in ophthalmology specialist knowledge is essential for correct interpretation of what is seen with the ophthalmascope and the slit lamp.



FIG. 158
This cystoscopic painting shows diffuse glow of light and the absence of highlights. A case of sulphonamide oliguria.



FIG 159
This gastroscopic painting on the other hand shows well-defined highlights, which are typical when air distension is employed. A case of chronic peptic ulcer. Figs. 55 56, 157 and 158 are by courtesy of Miss Dorothy M. Barber

Any one new to this type of work should seek the help of another artist who is an expert in this branch of medical illustration. An ophthalmologist will teach the anatomy of the eye, and tell the artist what he should see in

the cases under consideration, but he will probably not be able to show him how best to record what he sees.

Nowadays the fundus camera takes beautiful pictures of the fundus of the eye, and some authorities consider it unnecessary for any artist to do this type of work. It is true however that occasionally medical specialists in ophthalmology still prefer a few of their cases to be painted by hand, so that some knowledge of fundus work is an asset especially to the full time hospital artist.

Elsewhere comment has been made on the use of one or more colours for accentuating structures and to focus attention on certain points. With an ink drawing, the addition of one colour is a simple matter for the block maker. With half tone this is not so easy and it is the writer's opinion that any colour added to a half tone basic drawing should take the form of tinting. In this way the under lying drawing and form will show through the tint, whereas a solid colour will hide the under lying form (Fig. 160).

By 'colour' most people mean a painting, done in water colour or oil paint, or a coloured photograph. To reproduce a coloured illustration requires a minimum of 3 blocks, one for each primary colour blue, red, yellow and with black added each picture has to be printed four times. One 3 × 3 block would probably cost about £30 against 35/ for a half tone block of similar size, but only in exceptional circumstances would any publisher make a

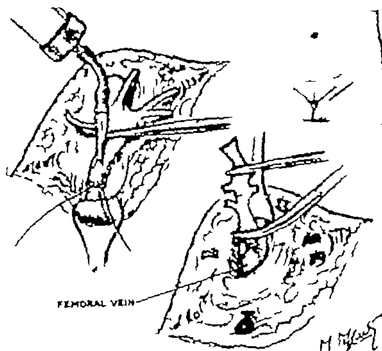


Fig. 160

The Trendelenburg operation combined with the injection of sclerosing solution in the treatment of varicose veins.
(From *Operative Surgery* by kind permission of Mr R. L. Farquharson).

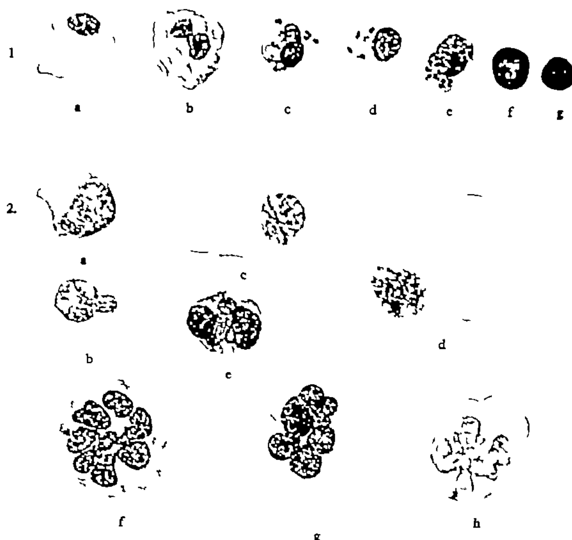


FIG. 161

SECTION 1. Miscellaneous Cells.

a b Gaucher's disease.
Leishman Donovan bodies in monocyte (Kala Azar).
d & Leishman Donovan bodies in reticulum (Kala Azar).
f & g —Haemotogones from aplastic anaemia.

SECTION 2. Megakaryocytes.

Megakaryoblast.
b Immature megakaryocyte.
Partly mature
d Mature "
Early from normal marrow
f Multinucleate mature megakaryocyte from normal marrow
g Normal mature megakaryocyt from normal marrow
h 'Lymphoid' type from thrombocytopenic purpura.

(From *An Atlas of Bone Marrow Pathology*
By courtesy of Dr Israels, painted by Miss Dorothy Davison).

3 × 3 block *alone* It would be grouped with others to make up a minimum of 30 square inches and the cost might be reduced thereby to about 1/3 of the total if the blocks had been made individually

Microscopic pictures, if they are hand painted are nearly always in colour Photo micrography however has made such strides in recent years that here again it is almost unnecessary for the artist to do this type of work. The electron microscope is the most important development in this field it has brought into focus a new horizon of observ ation and visual study The artist comes into his own, however when individual cells are taken from various slides, or different parts of the same slide, and placed together for com parison as in Figure 161

Colour photography is the best way of recording physical signs and three examples from the 6th Edition of *Emergency Surgery* are shown in Figures 162, 163 and 164. On occasion over-exposure or under-exposure of the film might prove to be a difficulty but not to the hospital photographer who knows his film and the light factors and who, no doubt, has worked out a satisfactory set up of portable illumination which will be constant for most of his colour work. For instance, in the vitamin B deficiency condition of pellagra under-exposure of the photograph will make the disease appear more severe than it is, the colour of the patient's skin seeming darker than in fact it was. An under-exposed black and white film seems thin, but with colour under-exposure makes the colours appear denser and richer than they really are.

Most people who paint have their own ideas about what are the best papers or boards to work on. It seems that for medical work the surface of the paper or board should be smooth, and on the whole board is better than paper for if need be the board can be held under the tap to wash off the whole painting leaving only a faintly coloured ghost on which to start again.

Most artists use water colour pans in a box and sometimes a mixture of water colour and crayons or water colour and coloured pencils. There are so many varieties of crayons and



FIG. 62
Fish handler' disease.



FIG. 63
Gangrene resulting from frost-bite. The patient was Kentish farm labourer.

(Fig. 162 is from *Emergency Surgery* and Fig. 63 from *Physical Signs in Clinical Surgery* by kind permission of Mr Hamilton Bailey).

coloured pencils on the market that it is difficult to single out any one make as better than the others Casein-emulsion colour in jars is a new medium and can be diluted either with water or with oil so that both media may be used in the same painting (Fig. 165)

Many artists including the students at the Edinburgh School use crayon dust on Ross Board, the usual method being to combine the crayon dust with water colour to give the work more substance.

It is recommended that all paintings should be covered with Morane skin as this will ensure that they do not fade also, it will be invisible should the work be required for publication. The method of its application is described in Chapter IX.

By permission of Professor Allison a picture is included of the immediately post-operative appearance of a lung specimen drawn to actual size as the ink tracing which accompanies the painting will show (Figs. 166, 167 and 168) After the lung had been fixed and hardened in formalin the colour was brought back with alcohol and the cut surface was painted here the colour is a mixture of water colour and coloured pencil (Fig. 168)

It would be sad, if the camera completely ousted the artist from doing any illustrations in colour The psychological tonic of making



FIG. 164
Prolapse of iris due to injury
(From *Emergency Surgery* by kind permission of Mr Hamilton Bailey).

FIG. 165

This casein-emulsion colour has great covering qualities. It dries with a dull, velvet-like smoothness and soon becomes waterproof and resistant to rubbing. For work which will be copied on colour film, and for colour reproduction it is very suitable. Plaka is available in about 24 colours.

(By courtesy of G. H. Smith & Partners.)



1 Tracing on glass of fresh specimen



FIG. 166

Painting of left lung immediately on removal. The specimen was surrounded by greatly thickened and fibrosed pleura. Water colour only

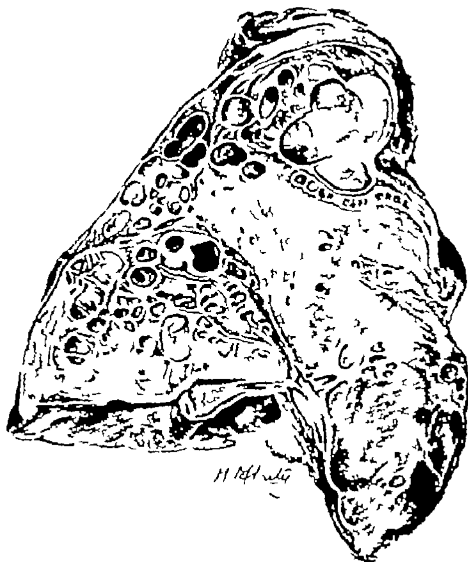


FIG. 67

The cut surface of the lung showed the upper lobe to be entirely replaced by numerous thin walled cavities, the largest measuring ·5 cms. in diameter. The lingula (bottom right) and central segments of the lung appeared fairly natural. Scattered throughout all segments were small nodular areas of fibrosis measuring up to cm. in diameter. The histological examination showed no evidence of active tuberculosis. Water colour and coloured pencil.

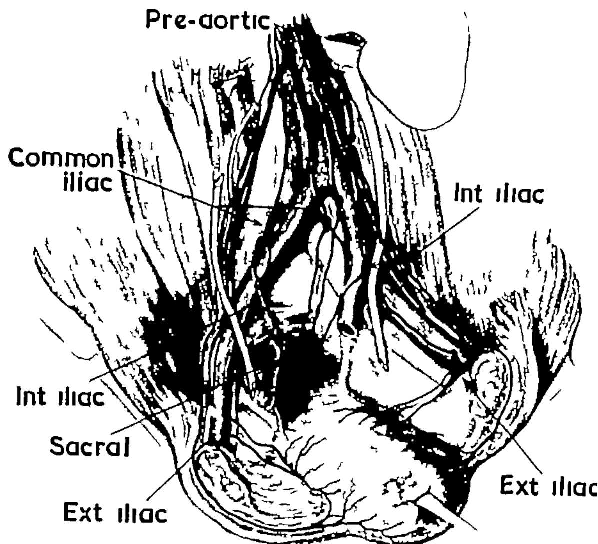


FIG. 68

A painting to illustrate the lymphatic drainage of the female pelvis The anatomy has been simplified as this picture was made for projection only for showing in a very large hall. (*By courtesy of Mr Hawksworth.*) Water colour and black ink. Process white was used for the highlights in Figs. 166, 67 and 68.

a painting every now and then should appeal to those who seem to spend more and more time on charts Whenever the opportunity arises to add colour to a chart or diagram do so Another method of adding colour to a black and white chart or diagram for projection is, during the fixing process of the slide, to dip it in pale green, blue or yellow dye and even this minimal colour can be very pleasant on the screen. More and more lecturers use the 35 millimetre or 2" × 2" lantern slides, and now that processing of colour film is so reliable, colour slides should be recommended by artists whenever it seems fitting to do so Most of the large industrial firms use coloured graphs in their reports and the difference in interest is outstanding Colour for projection on the screen is not expensive as it is in printing, so that it can be used without the question of cost having to be considered. Anatomical paintings such as Figure 168 can be executed in colour just as easily as in monochrome. Copying in colour is not difficult and the processing is reasonably quick so that most lecturers could use colour transparencies if they wished to do so Admittedly it might be impossible for a hospital photographer with a 20 exposure film in the camera to make only two or three exposures and then send the film off for processing, but cut film is available in sizes from quarter plate upwards.

Chapter XIII

A Filing System for Lantern Slides

SELECTING lantern slides for a lecture can take up considerable time because, even if there is a legend written on each slide, most people will wish to hold the slide up to the light to be reminded of the picture. The filing system which is described here is an inexpensive but efficient method, and can be used with ease either by an individual or by a department. The metal slide holders on the market with their illumination from behind which can be switched on and off constitute the ideal filing system, but the initial outlay is quite considerable.

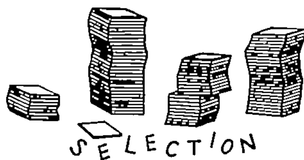
The following is a brief description of the system used in the Nuffield Department of Anaesthetics, Oxford, which has been found to be both economical and practical. No costly or even specialized equipment is required.

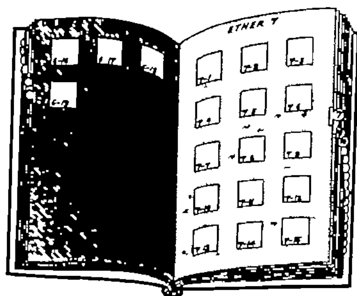
Each lantern slide in the Department is placed under a heading, such as Endotracheal Epidural, Ether and to each heading a number is allocated. When a lantern slide is required, a print $2'' \times 2''$ is made at the same time. Each print is given a number as well as the number which shows to which heading it belongs thus each slide and its corresponding print bears two numbers, the first number indicating the heading to which the slide belongs, and the second for its position under that heading. The same numbers are written in white ink on the accompanying negative of glass or film. These 2 2 prints are stuck into an album, either of the standard photographic type or the instantaneous binding type, where new pages can be added as required. It is therefore possible for anyone to see in front of him *pictures* of all the available slides on any particular subject, and it is easy to note down the numbers of the necessary slides for a lecture.

Lantern slides are made from each illustration in all the books and papers written in the Department. The small $2'' \times 2''$ prints are numbered this time with the Figure numbers in the book, and pasted into an album. In this way it is possible to have as many as 15 pictures, of a size large enough to be seen clearly on one page of an album (Fig. 169). Any new assistant who comes to the Department can soon become familiar with the departmental slides by studying these albums.

Even where only a few slides are used, it is a good idea to have, say five prints pasted on to long narrow leaves, clipped together and filed in the boxes or drawers which hold the lantern slides (Fig. 170). The standard lantern slide or negative-container holding 40-50 slides is seldom much larger than $12 \times 5 \times 4$ so that prints arranged as in Figure 169 will easily fit into or lie on top of such a slide container (Fig. 170).

These small prints are also very useful in any department where photographic records are in constant use. A patient's name may be forgotten after several years, but a drawing or photograph can be remembered and easily located in the album. Prints can be made, too, from colour transparencies, in black and white, and where the lantern slides are for a





(A)

SELECTION



(B)

Fig. 69

small projector these prints are even more useful, as they are considerably larger than the pictures on a 2″ × 2″ slide. The actual size of the picture area on a Kodak Ready Mount

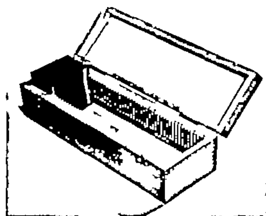


Fig. 7
Storage and transit box, this one holds 50 slides, 3¼ 3¼ inches (By courtesy of Johnson of Hendon Ltd).

for 35 millimetre slides is 1.3 by 0.9 inches, and into this space the picture must be reduced.

In the Department of Anaesthetics these print books are in constant use, and are invaluable when, for instance, a new drawing of a later model of some instrument or appliance is urgently required. Incidentally an artist will be reminded of things which could be better of things which were good, and things not to be repeated! It is borne out in practice that a drawing which makes a really good print when reduced so drastically will also make a really good slide.

It is much easier to give a lecture with a handful of slides than without even the simplest slide can explain points to the audience more graphically than the spoken word. Figure 171 is one of the simplest slides in the Department, but it demonstrates a matter of life and death.

Colour on lantern slides is not only a matter of colour transparencies. Almost any ink or half tone drawing may have colour added, when the slide is of the standard variety To paint on a picture area approximately three inches square need not be too difficult, the most difficult type to paint being a picture which requires an even wash effect. If the colour is diluted with ammonia instead of water it is easier to put on. Ammonia, too, will wash out mistakes, but it is much better not to have any! Coloured inks are on the market especially prepared for use in painting on lantern slides and photographic prints An ink drawing (Fig 172) photographed directly on to a lantern slide plate appears

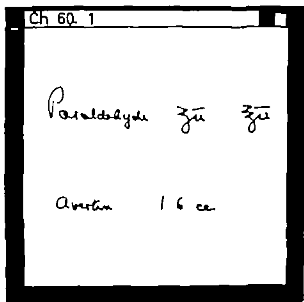


Fig. 7a
The difference between two drachms and two ounces of Paraldehyde does not seem so obvious as ·6 cc of Avertin being read as 6 cc. Both misreadings would mean death for the patient, two ounces being equal to sixteen drachms. (By permission of Nuffield Department of Anaesthetics, Radcliffe Infirmary Oxford.)

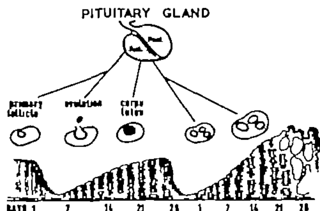


FIG. 72

Composite diagram to show the endometrium in two successive cycles. Ovulation occurs in the first but not in the second. The result is cystic ovary with associated hyperplasia of the endometrium followed by its break down and bleeding.

(By courtesy of Mr John Stallworthy).

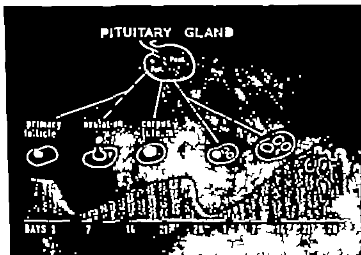


FIG. 73

This picture was drawn for and used as lantern slide. The egg in the ovulation diagram was painted yellow and the right hand margins of the wall of the endometrium were coloured red. This picture illustrates that 'spilling' of the colour would be unimportant

(By courtesy of M John Stallworthy

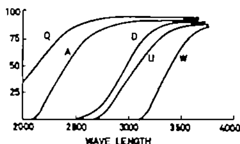


FIG. 174
A simple chart of wave lengths of the different types of electricity used in electrotherapy
(*By courtesy of Dr B. O Scott*).

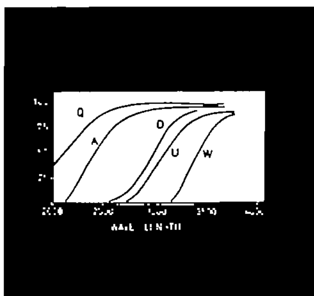


FIG. 75
The same chart presented as lantern slide. This involves an extra photographic stage. Fair comment would be that the lines of the curves in both charts should be thicker

on the screen as a white drawing on a black ground (Fig. 173). Another method of using the white on black method is shown in Figures 174 and 175. It will be appreciated that any colour may be used behind these curves, and the colour here could be a piece of coloured cellophane bound between the lantern slide plate and the cover glass. This is ideal for the type of picture in which colours are used to differentiate the structures or curves. Inaccurate painting of these lines or structures will not show against the opaque black of the background. In half-tone drawings too, such things as nerves and vessels may be coloured, but very great care is needed, as the enormous magnification of a picture on the screen should not be forgotten, and 'spilling' the colour over a line or structure looks very bad. It is always best, where possible, to use the white on black method as it is much less tiring for the eyes of an audience. The only disadvantage is that when material is photographed directly on to a lantern slide plate, the original item must be re-photographed to produce a new slide should the plate get broken or lost, whereas with a negative available a new slide can easily be made. For statistics, etc., which are so often quickly out of date, direct photography on to the lantern slide plate or film is an ideal method.

The following are points worth remembering when making or ordering lantern slides.

1. A slide should be as clear and simple as possible. Unlike an illustration in a book it is only shown on the screen for a matter of seconds or minutes.

2. The selection of the pictorial material should, as far as possible, fill the space available, which in the case of the standard 3¼ × 3¼ slide is a square, and in the 35 millimetre or 2″×2″ variety in the proportion of about 2 to 3 (1.3 × 0.9″ being the picture area).

3. Half-tone illustrations from books (and this includes all printed photographic material) do not make nearly such good slides as the original drawings or photographs. The reason for this is that the blockmaker's screen, however fine, is composed of dots, and these are magnified on the screen, to the detriment of the picture.

Drawings which include many labels to identify different parts are not really suitable as lantern slides. Similarly complicated tables and charts are to be avoided. Professor Tom Jones* of Chicago calls these latter "Oh Hell slides". The automatic reaction of the audience to such slides makes this description very apt. Figure 176 would be quite satisfactory in a journal, but as a lantern slide it tends to qualify for the category described by Professor Jones! It is not a good idea, for instance, to put a photograph of a patient, the tumour which was removed *and* a temperature chart all on the same slide. It is much better to have two or even three slides, and the question of weight, when travelling by air to give a lecture, is negligible when using the 35 millimetre variety. Anything which contains too much information or is in the least difficult to read (and this applies especially to the people at the back of the hall) should be rigorously avoided.

---

* Jones, T. S. The Art of using Lantern Slides, from *Studies in Medicine*, Volume of papers in honour of Robert Wood Keeton.

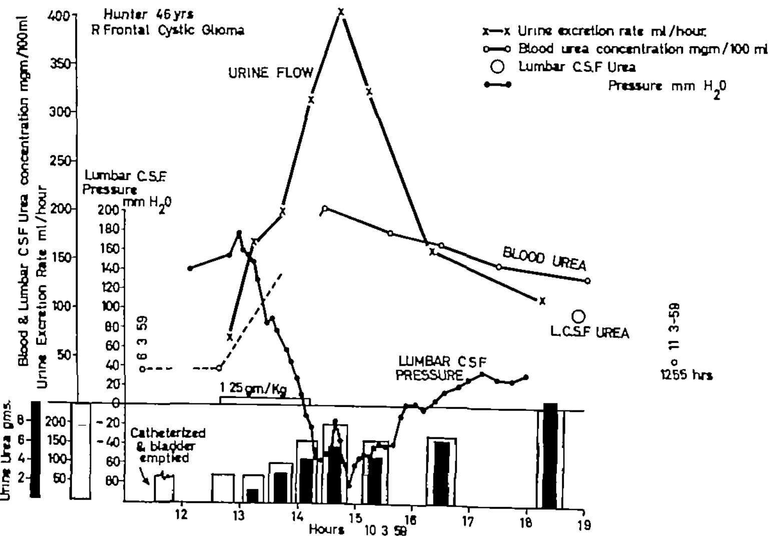


Fig. 176

The author considers this chart ideal for Journal where space is an important factor and as much information as possible should be given in the space available. For use as lantern slide, however it is too complex for the eye. (B courtesy of Dr John Stubb.) This chart was designed for publication.

Chapter XIV

Some Problems of Reproduction and Printing

ECONOMY demands that printing of sheets for books should be carried out in units of eight, sixteen, and very often thirty two pages at one time. These units are known as "signatures" and the pages must be arranged in such a way that they read consecutively when folded into a pamphlet or section of a book. The placing of the pages is known as "Imposition". An example of an imposition of thirty two pages is illustrated in Figure 177. This will eventually be folded into two signatures of sixteen pages, the first consisting of pages one to sixteen and the second of pages seventeen to thirty two. Various impositions are used by printers depending on the make of folding machines to be used in the ultimate binding of the book.

When an engraver submits proofs for approval it must be remembered that each illustration is treated individually and he is able to control the amount of ink on each subject. A printer however is required to print several illustrations at one time and the flow of ink has to be averaged over the thirty two pages, but he has a limited amount of control over each individual row of pages marked "a-h" on the diagram. If two illustrations appear in row "a" and one requires a greater amount of ink than the other the printer must strike an average. This explains why the final printed sheet may show a little variation from the blockmaker's proofs. The difficulty is increased fourfold when coloured printing is involved as the density of colour may vary

a b d f g h

Fig. 177

An imposition of thirty two pages.

from one illustration to another in each of the four colours involved.

The qualities of paper employed at different stages of production sometimes show variable results It is always advisable to ask the engraver to submit his proofs on paper similar to that used for final printing, other wise he is liable to use a more expensive, highly coated chromo paper of heavier weight and, as each illustration receives individual attention he will get results that cannot be obtained on the larger printed sheet of lighter weight and less expensive quality Much disappointment will be avoided if these facts are appreciated.

LINE ILLUSTRATIONS

The technique of making a line block has already been described (pages 39 47) so that it is only necessary to remind the reader that this process serves for the reproduction of black lines on white ground and it is not possible to take any account of middle tones. The original is reproduced in relief while the spaces in between are etched away It is therefore of considerable importance, if a result is to be achieved satisfactory alike to artist and the user of the block, that the original drawing should consist of definite black lines on a smooth white ground. All effects which are produced by uncertain lines and by wash tints must always be avoided.

Line drawings with areas of flat colour or with coloured lines or stipples *should not have colours painted directly on the drawing* The coloured parts should be drawn in black, each colour separately on a transparent cover (such as Astrafoil which is stable to atmospheric conditions) register marks being drawn to ensure accurate fitting. If the subject is at all complicated a rough sketch in actual colour should be made as a guide. Alternatively a tracing may be made and the colours added to it.

While designs in black and white are reproduced by the line block, the half tone block deals with subjects where there is variety in tone such as in wash drawings. This process really depends on an illusion. In typographic printing, it is only possible to print solid areas of ink on paper and tonal variety is obtained by breaking up the subject into dots of varying size (Fig. 178)

These dots are equally spaced and each carries an amount of ink proportionate to its size. Thus light tones are represented by small dots, medium tones by medium sized dots, and heavy tones by heavy dots. The resulting print must be viewed at a suitable distance so that individual dots are not selected by the eye but are blended into uniform tone. Almost any type of subject can be reproduced by this method.

Half tone screens vary in size between 45 lines and 150 lines to the inch, but those most generally used in medical illustrations are 133 and 150, depending on the type of paper used. Screens of 45 85 are suitable for newspaper 100 120 for good machine finished papers, and 133 150 for coated papers

Half tone drawings with flat areas of colour should be prepared by a method similar to that prescribed for line drawings.

THREE AND FOUR COLOUR ILLUSTRATIONS

It may be of interest to recall that three and four-colour printing is the direct outcome of experiments in colour vision undertaken during last century by an Edinburgh physician. Dr Thomas Young worked out a theory which was further developed by Helmholtz and Clerke Maxwell. In 1861 Maxwell showed the first definite experiment in three

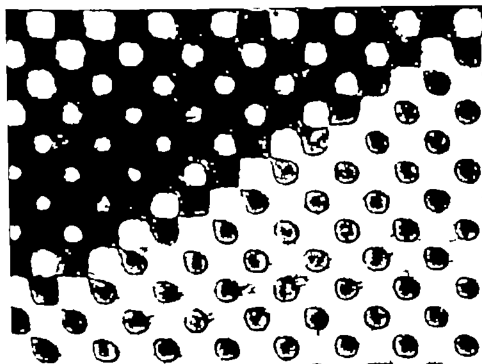


FIG. 178

Half tone screen, 150 lines to the inch magnified sixty times.

colour photographs. Three images one in red, one green, and one blue were superimposed on a screen by three magic lanterns and later work showed the possibility of printing three superimposed impressions upon paper using the three primary colours, yellow red, and blue and thus securing a reproduction in colour

As is the case with half tone blocks in black the process depends on optical illusion, the close proximity of blue and yellow dots giving the illusion of green, and similarly with combinations of other primary colours.

Very rarely does an engraver achieve facsimile reproduction on his first proof. Although great strides have been made in the manufacture of printing inks it has not yet been possible to obtain pigments which completely match the colours of the spectrum. Consequently the engraver has to *re touch* or to use the engraver's technical term, *fine-etch* his plates. By doing so he helps to compensate for the deficiencies of the printing ink. Do not be disheartened, therefore, if the first proof submitted by an engraver does not come up to your expectations. Criticise it freely and in most cases you will find that the second proof approaches very near to your original.

TEAM WORK

Successful reproduction is the result of team work. Author publisher artist, photographer engraver printer and papermaker should work towards the same end the presentation of the subject in the most suitable way

When preparing illustrations for repro-

duction, always consult with the publisher before putting pen or brush to paper. Much time and labour can often be saved when this is done. When making a drawing which is *not* for reproduction the artist may do exactly as he pleases: the finished drawing is the end result. In working for reproduction, however, the original drawing must be regarded as *a means to an end,* that end being the presentation of the illustration to the reader of the book.

Even with perfect drawings some change is inevitable in the course of transition from drawing to page. *The artist should compare* his originals carefully with engravers proofs *and observe what has reproduced well and* what is not so good. The experienced artist *soon learns how to adapt his technique.* Note particularly the effect of reduction. One style of drawing may reduce by two thirds without serious loss while another may give better results when reduced by only one third.

When illustrations are a mixture of photographs and drawings, artist and photographer should work together and not as rivals. Do not insist on making a wash drawing when a photograph will illustrate the subject equally well. Again, where a line drawing is more suitable than a photograph, do not hesitate to say so. Half tone blocks are much more expensive to produce. Do not use colour merely to produce a pretty picture but only to explain the subject more clearly than in a black and white illustration.

GENERAL CONSIDERATIONS

Great care should be taken in sending drawings by post. Careless packing has rendered many a good illustration useless. Cracks and marks are difficult to eliminate. Never mark drawings with a hard pencil: a *3B* pencil costs no more *and is less likely* to indent an illustration. All drawings should be *covered with an overlay to keep the surface* clean. Avoid the use of pins and paper clips. *Many illustrations* intended for reproduction are irreparably damaged when attached to a manuscript in this way.

BIBLIOGRAPHY

Clerc, L. P. (1940) *Ilford Manual of Process Work,* 3rd Ed. London: Ilford Limited.

Dent, A. E. (1946) *Practical Printing and Binding,* ed. Whetton, H. London: Odhams Press.

Gamble, C. W. (1950) *Modern Illustration Processes,* 3rd Ed. London: Pitman.

Master Process Engravers (1952) *Handbook of Process Engraving.* London: Federation of Master Process Engravers.

APPENDIX I

CORRECTION OF PROOFS

THROUGHOUT the years those engaged in various arts and crafts have sought a language of signs and marks to convey visually their ideas and instructions. The object of a sign or mark is to save unnecessary writing and in the correction of manuscript and printers' proofs a shorthand has evolved which is more or less standard. The most commonly used of these signs is given in the following chart

Mark	Example	Meaning
ð/	most artists can draw/	delete
⁀/	most art⁀ists can draw	close up
]	most artists can draw]	move to left
[	[most artists can draw	move to right
trs /	most[can draw]artists]	transpose
(?t)	most artists can(?)draw	query to author
stet/	most artists can draw	let it stand
l.c./	most artists can(D)raw	lower case letter
caps/	most artists can draw	capitals
#/	most artists can^draw	space
“/ ”/	/most artists can draw/	quotation marks
=	most artists can draw	align
*/	/most artists can draw	insert reference mark
NP	[most artists can draw	new paragraph
⊙	most artists can draw/	period
ital/	most artists can draw	put in italics
bold	most artists can draw	put in bold face
X	most art(i)sts can draw	broken letter

APPENDIX II

CONVERSION FACTORS FOR IMPERIAL AND METRIC WEIGHTS AND MEASURES

WEIGHTS

grains × 0·0648 = grammes
drachms (Apothecaries) × 3·8879 = grammes
ounce (Apothecaries) × 31·1035 = grammes
ounce (Avoirdupois) × 28·3495 = grammes
pounds (Avoirdupois) × 0·4536 = kilogrammes

---

grammes × 15·432 = grains
grammes × 0·0322 = ounces (Apothecaries)
grammes × 0·0353 = ounces (Avoirdupois)
kilogrammes × 2·2046 = pounds (Avoirdupois)

FLUID MEASURES

minims × 0·0592 = millilitres
fl. drachms × 3·5510 = millilitres
fl. ounces × 28·4077 = millilitres
fl. ounces × 0·0284 = litres
pints × 0·5682 = litres
gallons × 4·5460 = litres

---

millilitres × 16·8968 = minims
millilitres × 0·2816 = fl. drachm
millilitres × 0·0352 = fl. ounces
litres × 35·2000 = fl. ounces
litres × 1·7598 = pints
litres × 0·2200 = gallons

THERMOMETRIC CONVERSION FORMULAE

Relation between Degrees Centigrade (°C)
Degrees Fahrenheit (°F) and Degrees Réaumur (°R)

Fahrenheit to Centigrade
$T°C = 5/9\ (T°F - 32)$

Réaumur to Centigrade
$T°C = 5/4\ T°R$

Centigrade to Fahrenheit
$T°F = 9/5\ T°C + 32$

Réaumur to Fahrenheit
$T°F = 9/4\ T°R + 32$

Centigrade to Réaumur
$T°R = 4/5\ T°C$

Fahrenheit to Réaumur
$T°R = 4/9\ (T°F - 32)$

APPROXIMATE EQUIVALENTS

WEIGHTS—IMPERIAL TO METRIC

Grains		*Milligrammes*	*Grains*		*Milligrammes*	*Grains*		*Grammes*
1/1000	=	0 065	1/6	=	11	6	=	0 39 (390 mg)
1/300	=	0 22		=	12	7½	=	0·49 (490 mg.)
1/100	=	0·6		=	16	10	=	0·65 (650 mg.)
1/64	=	1	1/3	=	22	12	=	0 8 (800 mg)
1/50	=	1 3	1/2	=	32	15·4	=	1
1/40	=	1·5		=	50	20	=	1 3
1/30	=	2	1	=	65	30	=	1·9
1/25	=	2 5	1½	=	100	45	=	2·9
1/20	=	3	2	=	130	60	=	3·9
1/16	=	4	3	=	195	90	=	5 8
1/12	=	5·4	4	=	260	120	=	7 8
1/10	=	6 5	5	=	325	150	=	9 7
1/8	=	8				180	=	11 7

½ ounce (Avoirdupois) = 14 18 grammes
1 ounce (Avoirdupois) = 28 35 grammes
1 pound (Avoirdupois) = 453·6 grammes

MEASURES—IMPERIAL TO METRIC

Minims		*Millilitres*	*Minims*		*Millilitres*	*Fluid Ounces*		*Millilitres*
½	=	0·03	17	=	1	1	=	28·4
1	=	0·06	20	=	1 18	2	=	56 8
2	=	0 12	25	=	1·48	4	=	113·6
3	=	0 18	30	=	1 78	5	=	142·0
4	=	0 24	40	=	2 37	6	=	170·4
5	=	0 30	45	=	2·66	8	=	227 3
6	=	0 36	60	=	3 55	10	=	284 1
8	=	0·47	90	=	5 33	20	=	568 2
10	=	0 59	120	=	7 10			
12	=	0 71	240	=	14 20			
15	=	0 89						

GLOSSARY

ABDOMEN.—Extends from the brim of the pelvis to the diaphragm bounded at the sides and in front by the abdominal muscles and behind by the spinal column.
ABSCESS.—A circumscribed collection of pus.
ACETATE.—Or cellophane acetate, transparent non stretch, non-shrink material made from wood pulp.
ACROMEGALY.—A chronic disease of the bones of the head, hands and feet which become enlarged, see p. 105.
ACTINOTHERAPY.—Transmission of violet and ultra violet rays as curative agent.
AIR BRUSH.—Used to blow fine spray of liquid colour see p. 80.
ALBUMIN COLOURS.—Transparent colours for use on photographic prints, film, or lantern slides.
ANAESTHESIA.—Insensibility to pain with loss of consciousness produced by an anaesthetic agent.
ANAESTHETIST.—One who administers an anaesthetic.
ANALGESIA.—Absence of pain.
ANATOMY.—The science of the structure of organisms and the relation of their parts, see pp. 14.
ANTERIOR.—In front.
ANTIQUARIAN.—Size of drawing surface 54 32 inches, see p. 7
ANTERO POSTERIOR.—Front to back (A.P.)
ANUS.—The lower opening of the alimentary canal, see Figs. 11 19.
ARTEFACT.—A structure or tissue that has been changed from its natural state, see p. 7
ARTYPE.—Black or white letters printed on adhesive backed acetate, see p. 30.
ASTROFOIL.—Tracing paper acetate backed, non stretch, non-shrink
ASEPSIS.—Absence of pathogenic micro organisms see p. 5
AXILLA.—Armpit.

BEN DAY TINT. See mechanical tint, p. 47
BENIGN.—Not malignant.
BLEED.—The arrangement of page so that the pictorial surface goes right to the edge of the paper
BRACHIAL.—Relating to the arm.
BRACHIAL PLEXUS.—Anterior primary division of the 5th, 6th, 7th and 8th cervical and st thoracic nerves passing over the st rib into the axilla, see p. 09.
BRISTOL BOARD. A fine quality of cardboard composed of two or more sheets pressed together the substance of the board being determined by the number of sheets, see p. 55
BRITISH STANDARDS INSTITUTION.—2 Park Street, London, W non profit making concern to co ordinate the efforts of producers and users for the improvement, standardization and simplification of engineering and industrial materials. Section Lists are issued gratis and those most likely to be of interest here are a. Chemicals, fats, oils scientific apparatus. b. Drawing Instruments c. Personal safety equipment. d. Symbols Signs and Abbreviations.

BRONCHUS.—Air passages leading from the trachea to the lungs.
BRONCHOSCOPY.—Visual examination of the bronchi with bronchoscope.

CADAVER.—A dead body body in a dissecting room.
CAECUM.—The blind part of the large bowel into which the appendix enters.
CAMERA LUCIDA.—Attachment for microscope by which objects seen through the eyepiece are projected onto table or paper alongside it, see p. 124.
CARBON PAPER.—Thin paper surfaced with preparation of mineral colours plus fatty substance used for duplicating.
CASEIN COLOUR.—See Fig. 65
CELLOPHANE.—Transparent wrapping material.
CEREBRAL.—Pertaining to the brain.
CEREBRO SPINAL. Pertaining to the brain and spinal cord, see p. 51
CLINICAL.—Relating to bedside treatments.
COLON.—The large intestine.
COLOUR FILTER.—Coloured gelatine film cemented between glass and interposed between the camera lens and the object to be photographed i.e. to "filter out certain colours.
COMPOSITE BLOCK.—A block made up of tw or more originals, or drawing and legends, see p. 79.
CONDENSED LETTERS.—Upright narrow letters, see p 24.
CORNU.—Any structure resembling horn.
CORONAL.—Horizontal section usually applied to the head and neck. See p. 19.
CORTEX. Peel or bark, part of the brain.
COW GUM.—Rubber solution gum made from petrol (I.B. Cow and Company Ltd.).
CYCLOPROPANE.—Rapid anaesthetic agent, see p 58.
CYSTOSCOPY Visual examination of the bladder with cystoscope see p. 28.

DETAIL PAPER. Similar to tracing paper though more opaque.
DIAPHRAGM.—A partition, the muscle dividing the chest from the abdomen.
DIATHERMY Transmission of radiant heat as curative agent or for the cauterization of blood vessels by electricity in surgery
DISTAL.—Away from the centre of the body or of the point of attachment.
DORSAL. The upper surface of any part of the body
DOTTING PEN.—A ruling pen having wheel with serrated edge for drawing dotted lines.
DOUBLE. Applied to paper sizes i.e. double elephant 40 26½ inches
DUOGRAPH. Lettering guide, see p. 7
DUCT A channel for the passage of fluid.

Ectomy.—Indicates the surgical removal of an organ or structure (Appendicectomy).

Electron Microscope.—Modern microscope showing enormous magnification, see p. 131

Electronic Flash.—Synchronized camera attachment for flash illumination plugged into mains as distinct from flash bulbs.

Electrotherapy.—The use of electricity as curative agent.

Electrotype.—Facsimile made by deposit of copper on mould of wax or lead and backed with lead alloy by galvanised action.

Elephant.—Size of paper 28×23 inches, see p. 7

Endometrium.—The lining of the uterus or womb (endo, within).

Endoscope.—Instrument for visual examination of internal organs, see p. 128.

Engraver.—One who cuts in lines on metal, wood or stone for printing, see pp. 75 45 147

Epi.—Upon, over or above.

Epidiascope.—Projects drawings or pictures from books as distinct from lantern slides, see p. 124.

Ether.—Anaesthetic agent when vapourized, see pp. 54, 58.

Ethyl Chloride.—Anaesthetic agent when vapourized, see p. 32.

Expanded Letters or Type.—Those of unusually wide face.

Fascia.—Fibrous membrane.

Fashion Board.—Smooth surface board for water colour monochrome, etc.

Flexichrome.—Process in which photographer makes a relief print and an artist applies the colours (Kodak).

Foramen.—An aperture.

Forceps.—Used in surgery for holding tissues and sealing off blood vessels, see pp. 48, 90.

Format.—The size, shape, style and general appearance of book.

Formalin.—Preservative solution and disinfectant made from formaldehyde, see p. 32.

French Curves.—Curves cut out of wood or perspex for assistance in drawing graphs, etc., see p. 9.

Fundus.—The base of an organ, that part furthest removed from the opening, see p. 129.

Galley Proof.—A rough proof of type matter taken for the purpose of checking and correcting, usually about 18 inches long.

Gestetner.—Duplicating process.

Grain.—The direction in which fibres lie in piece of paper, see p. 57

Grapholite.—Display letters made of cork, see p. 29.

Graphos Pen.—Drawing ink pen for lettering and technical drawing, see p.

Grid.—Logarithmic or graph paper see p. 39. Squares ruled on transparent acetate for the purpose of enlarging or reducing drawings to scale see Figs. 51 52.

Ground Glass. Opaque glass with one smooth and one rough surface used in camera focusing screens and in viewing boxes, see p.

Guillotine.—A machine for cutting or trimming the edges of paper or card, see p. 18.

Haemorrhage.—From haima = blood; and rhagia = bursting forth.

Half tone Block.—One in which the tones are made by dots see p. 63 Fig. 82.

High Key.—Used to describe a photograph of light contrast and sharp definition.

High Light.—The whitest part of any picture.

Histology.—Examination of the minute anatomy of tissues with microscopic aid.

Homogeneous.—Of uniform structure throughout.

Horizontal.—Parallel to the horizon.

Hot Pressed.—Hard and smooth water colour paper see p. 78.

Hyper.—Over or above.

Incision.—A cut.

Inset.—A key or explanatory illustration incorporated in drawing or photograph, see Figs. 07 120.

Insert.—An extra page inserted in book. An additional sentence added to proof to appear in final copy

In Situ.—Any part of the body or an object seen in its usual environment, undisturbed, see p. 27

Kodatrace.—Transparent acetate backed by tracing paper non stretch, non-shrink, see pp. 56 64.

Laparoscopy.—Visual examination of the abdomen.

Laryngoscopy.—Visual examination of the larynx.

Larynx.—The organ of the voice.

Lateral.—The outer aspect from the midline of the body

Layout.—The plan of drawing or even of an entire book.

Leader.—The line joining point on drawing with the explanatory word or letter see pp. 49, 64.

Letraset.—Letters from specially printed type sheet which can be transferred to any art surface without transfer film or background, see p. 3

Letterpress.—Printed matter as distinct from illustrations.

Ligature.—Sealing off blood vessel by means of catgut, nylon, silk, etc. Two or more letters joined together (æ).

Line Block.—A printing block consisting of solid areas and lines, see pp. 46, 146.

Line Board.—Similar to Scraper Board, from Colyer and Southby Tooks Court, London, E.C.4

Lino Cut.—Engraving made by hand on linoleum.

Lithography. The art of printing from stone, or from zinc or aluminium plate, invented about 796.

Linotype.—Type setting machine making lines in one piece by means of keyboard.

Local.—Limited in area.

Lumbar. Relating to the lower part of the back, the loin.

Lumbar Puncture. The insertion of needle into the spinal canal in order to withdraw cerebrospinal fluid (C.S.F.) see p. 5

MASK.—Surgical, worn by everyone in an operating theatre to prevent droplet contamination from nose and mouth.
Used to control margins in air brush technique, see p. 81
Used photographically in lantern slides or to obliterate part of photograph.

MECHANICAL TINT.—A tint added to line block by the engraver as distinct from any already on the drawing, see p. 47

MEDIAL.—Towards the midline of the body

MESENTERY.—A fold of tissue connecting the intestine with the posterior abdominal wall.

MICRO.—Prefix meaning small, visible only through microscope.

MICRO PHOTOGRAPH.—Very small negative film intended for enlargement or printing.

MIMEOGRAPH.—Duplicating process (American).

MOCK UP.—Pictures pasted into position to form page lay-out.

MONTAGE.—See Photo Montage.

MORANE ADHESIVE SKIN.—Protective film for covering drawings or photographs, applied by heat pressure in dry mounting machine, see pp. 69 32.

MORPHIA.—Anaesthetic drug.

NECROSIS.—The death of cells surrounded by living tissue.

NEOPLASM.—New growth, used with reference to tumours.

NEUROSURGERY.—Surgery of the nervous system, see p. 6.

NEWSPRINT.—The lowest grade of printing paper

OBLONG PAGE.—A page where the picture matter runs upwards instead of across, see Fig. 50.

OCCIPITAL.—Relating to the back of the head.

OFFSET.—A process of printing from litho stone or plate by transfer to rubber cylinder which is then pressed on to the paper

OLEOGRAPH.—Lithography which simulates oil painting and is mounted on canvas, sized and varnished.

OPHTHALMOLOGY. The science of the eye see p. 28.

OPTIC. Pertaining to the eye, see p. 95

OSTOMY.—Indicates the introduction of drainage tube into an organ by surgery Caecostomy

OVARY.—The egg bearer

OVERLAY.—Tracing paper or Kodatrace attached to drawing to indicate where labelling mechanical tints or colours should be used, see pp. 49, 146.

PAKOLOR. Home processing colour outfit, film and paper Johnson of Hendon Ltd.

PAPILLOMA. A benign epithelial tumour

PATHOGENESIS The origin and development of disease.

PATHOLOGY.—Medical science dealing with modifications of function and changes in structures due to disease, see p. 4.

PANTOGRAPH.—A device for enlarging or reducing drawings.

PELLAGRA.—Vitamin 'B' deficiency disease.

PENTOTHAL.—Anaesthetic drug.

PERICARDIUM.—The closed sac enveloping the heart, see Fig. 106.

PERSPECTIVE.—The art of drawing an object to give the impression of solidity or three dimensions, see p. 32.

PHOTOGRAVURE.—A process of producing by photographic action an incised metal surface for printing from.

PHOTOMICROGRAPH.—Any photograph taken through microscope.

PHOTOMONTAGE.—Any photograph combined with drawing or other photographs to make picture, see p. 107

PHOTOSTAT.—Machine which produces facsimiles on sensitized paper from print or illustrations.

PLASTITONE.—Sheets of dots, lines or hatching printed on transparent acetat with adhesive backing, known also as pre-drawn shading film. Ditto Lustre finished.

PHYSIOLOGY.—The science of the vital processes of living organisms, see p. 14.

PLEURA.—Semi transparent sac enveloping the lung, see p. 47

PLEXUS.—A braid or network of nerves or vessels.

PRESTAX.—Sheets of dots, lines or hatching printed on transparent acetate with adhesive backing, known also as pre-drawn shading film. Ditto Lustre finished.

PRINT.—An impression made from photographic negative or printing block.

POST-MORTEM.—After death.

PROCESS WHITE.—Opaque white water colour see pp. 55 57 80 8 56.

PROOF CORRECTION.—See p. 149.

PROOFING PAPER.—Paper on which a 5H or 6H pencil draws line resembling ink when reproduced, see p. 62.

PROXIMAL.—Situated towards the centre of the body or the point of attachment.

PULL.—An impression of block for the purposes of checking.

PYLORIC STENOSIS (Congenital).—Constriction of the final portion in an infants stomach.

RECTUM.—The straight part of the large intestine opening into the anal canal.

REDUCING LENS.—A lens in which the concave surfaces of the glass are in the centre, see Figs. 9 and 56.

REGISTER MARKS.—Marks drawn on margins of original copy in the shape of cross, and which are reproduced in all the stages of a multicolour job to aid in obtaining exact and quick register when printing.

REPRINT.—A second or new impression or edition of any printed work.

RESIST. A coating applied to the surface of plate in order to prevent or retard the corrosive action of acid, see p. 75

ROAD PEN.—A double pen for drawing two parallel lines simultaneously synonymous with railway pen.

ROMAN.—Ordinary type see p. 24.

ROSS BOARD.—Stippled chalk surface board, see p. 65.

ROYAL. Standard size of printing paper 20 25 inches.

SAGITTAL.—A section through the body from front to back.

SCRAPER BOARD.—Board coated with chalk in white or black with a very smooth surface, see p. 54.

SCREEN.—A grating of opaque lines ruled at right angles on glass and fused together for making half tone blocks, see p. 63 Fig. 82.

SINUS.—An air cavity in a bone or other tissue.

SPHINCTER.—A ring like muscle closing an orifice see Figs. 1 2 119.

STANDARDGRAPH.—Lettering guide, see p. 24.

STEREOSCOPE.—An instrument by which two similar pictures of the same object are mounted so that the two images are seen as one giving three dimensional effect.

STIPPLE.—T engrave by dots instead of lines.

SYNDROME.—A group of symptoms or signs which when considered together indicate a specific disease see p. 105, Fig. 33.

TINT BLOCK.—A plate or lino cut used in printing a flat colour

TRANSPARENCY.—Positive image colour photograph, see pp. 137 138.

TRACING PAPER.—Semi-transparent paper treated with a solution of castor oil in alcohol, see pp. 56, 64, [illegible]

TRACHEOTOMY.—Emergency [illegible] in the trachea to relieve [illegible]

TUMOUR.—A new growth.

UNO.—Lettering guide see p. 25

UTERUS.—The womb.

VENTRICLE.—Cavity within the [illegible] cerebrospinal fluid.

VERTEBRA.—One of the [illegible] vertebral column, see p. 12.

VIGNETTE.—An illustration [illegible] off gradually

VIEWING BOX.—Opaque glass [illegible] behind for viewing X rays see p. [illegible]

WOLFF CARBON PENCILS, [illegible] Sovereign Pencil Co., see pp. [illegible]

X RAY.—The practice of [illegible]

ZIP-A-TONE.—Sheets of [illegible] printed on transparent [illegible] see p. 56.

INDEX

INDEX

Printed by PICKERING & INGLIS LTD Glasgow